

GENEALOGISTS' PERSPECTIVES ON THE USE OF INVESTIGATIVE GENETIC
GENEALOGY

by

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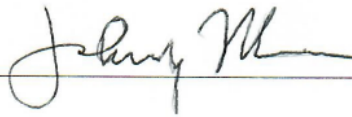
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For the College of Liberal Arts

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Abstract

GENEALOGISTS' PERSPECTIVES ON THE USE OF INVESTIGATIVE GENETIC GENEALOGY

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A new investigative tool, investigative genetic genealogy (IGG), combines traditional investigative techniques, DNA, and genealogy to identify the perpetrators of sexual assaults, exonerate falsely accused individuals, and identify human remains. IGG gained national attention with the arrest of the “Golden State Killer” in April 2018. This qualitative study examines genealogists’ perspectives on the use of IGG. Semi-structured interviews were conducted with eight participants, two of whom had experience using IGG. Results showed overall support for IGG when used with informed consent or legal process and in solving violent crimes; nevertheless, some participants expressed concerns with misuse, misidentification, consent, privacy, and confidentiality. To continue to be used, the public needs to be informed, skilled genealogists must be used, law enforcement needs to follow policy, and challenges in court and legislation will continue to set adequate policy.

Introduction

Julie Fuller, an 11-year-old, exited the motel room in Arlington, Texas, she was sharing with her family to take out the trash (Gordon, 2019). On the following day, June 28, 1983, her naked body was found in nearby Fort Worth (Gordon, 2019). She had been raped and strangled to death (Gordon, 2019). Although DNA had been collected from Julie's body, technology and knowledge of how to use DNA in criminal cases at the time could not help investigators solve her case (Gordon, 2019). Even with advances in DNA analysis and the formation of the Combined DNA Index System (CODIS), a criminal database of DNA samples administered by the FBI, the case would remain unsolved until more than 36 years later. Finally, on December 13, 2019, Julie's killer was identified; however, he would not be brought to justice due to his death in 2004 in Iowa (Gordon, 2019). Upon finding out the case had been solved, Julie's brother commented, "I didn't believe it. I didn't believe we were ever going to get to this. ...Honestly, we're glad he's dead. ...Just the thought of him and my parents, especially having, for them to go through that, of facing the guy, I think would just be horrific" (Sentendrey, 2019). Of his pain, Julie's brother stated, "I always kind of would beat myself up that maybe I should have been paying more attention and maybe not so into myself. The fact that I allowed my little sister to just wander off like that. ...I mean, she was just taking out the trash" (Sentendrey, 2019).

The identification of Julie's killer years later was possible using a new investigative technique that combines DNA analysis with genealogy (Gordon, 2019). This new technique is referred to by multiple names but is more popularly known as investigative genetic genealogy (IGG). It has also been used to identify the perpetrators of sexual assaults, exonerate falsely accused individuals, and identify human remains. In IGG, DNA profiles from crime scenes are compared to DNA profiles in genetic genealogy databases. Individuals submit their DNA samples through DNA test kits to trace their genealogy or look for relatives. The DNA test kits

are obtained from and submitted to commercial DNA testing services to generate the DNA profiles stored in the services' genetic genealogy databases. Law enforcement agencies use leads derived from genetic matches resulting from these comparisons to solve crimes.

In recent years, many of the crimes solved using IGG have been cold cases where all other investigative techniques had been applied with no success. In most cases, genealogists have assisted law enforcement officers. Genealogists spend hours of research using a variety of records to identify a potential suspect by finding kinship and pedigrees of individuals who are related based on DNA profiles. Without the public taking a genealogy DNA test and submitting it to databases accessible to law enforcement and genealogists, IGG would not be as successful in generating leads for law enforcement.

IGG gained national attention with the arrest of Joseph James DeAngelo Jr. on April 25, 2018, in Citrus Heights, California, just north of Sacramento. The 72-year-old former police officer was alleged to be the East Area Rapist and suspected of committing at least 51 rapes and 12 murders throughout California from 1974 through mid-1986 (Stanton et al., 2018). On June 29, 2020, DeAngelo admitted to committing multiple murders, rapes, burglaries, and other crimes that earned him the nicknames of the East Area Rapist, Golden State Killer, Visalia Ransacker, and Original Night Stalker (Stanton et al., 2020). On August 21, 2020, he was sentenced to life in prison without parole (Stanton & Smith, 2020).

Investigators developed DeAngelo's DNA profile from DNA he left at multiple crime scenes and uploaded the developed DNA profile to GEDmatch. GEDmatch is a public genetic genealogy database used by genealogy hobbyists to upload their DNA profiles from the various commercial DNA testing services. GEDmatch provides another way for individuals to find relatives and conduct genealogy research. The crime scene DNA profile was matched to a distant relative. With the help of genealogist Barbara Rae-Venter, investigators found a common

ancestor and built the branches of the common ancestor's family tree forward to identify a handful of potential men who fit the suspect profile based on age and time spent in California. With these leads, investigators applied traditional investigative techniques and matched a discarded DNA sample from DeAngelo to the DNA profile developed from the crime scenes.

During the sentencing phase, survivors of DeAngelo's crimes and family members of his murder victims provided victim impact statements over three days. Among those who provided statements, Kris Pedretti, who DeAngelo raped when she was 15 years old, stated, "Standing here today with the knowledge that DeAngelo will spend the rest of his life in prison for his heinous acts has ended my dark journey so that I may begin a new one" (Diskin, 2020). In addition, Debbi Domingo McMullan, whose mother was killed by DeAngelo when McMullan was 15 years old, stated, "Today the devil loses and justice wins...Today I am the victor in a battle of good and evil" (Diskin, 2020).

According to Katsanis (2020), from January 2015 to November 2019, IGG was used in 78 publicly disclosed cases. As a result, 15 unidentified human remains, two victims of suicide, and the perpetrators of one burglary, one assault, one sexual assault/burglary, 10 sexual assaults, two infanticides, two homicides/burglaries, 21 homicides/sexual assaults, and 23 homicides were identified. In addition, there were 70 victims of the combined 46 homicides (Katsanis, 2020). The oldest case was an unidentified human remains case from 1955, for whom the identity was announced in February 2019 (Katsanis, 2020). These investigations used two genetic genealogy databases used by genealogy hobbyists: GEDmatch and FamilyTreeDNA. Since November 2019, additional investigations solved with IGG have been publicized throughout the United States.

In representing the many families impacted by violent crimes, Thomas (2021) wrote about his perspective and observations as the older brother of a sister who, with her girlfriend,

were the first victims in a series of unsolved murders from 1986 to 1989, known as the Colonial Parkway Murders. Thomas described IGG as an “amazing tool” that can be used “on the toughest cases and continues to astound and amaze us as these seemingly impossible cold cases are broken one by one” (2021, p. 5). Thomas reminded us that the “families of America’s 200,000 cold case homicides and hundreds of thousands of sexual assaults are looking for ... answers, not necessarily closed cases or prosecutions” and asked that we “not forget the grateful reaction from family members receiving answers in their loved one’s cases, even if no prosecution results if the offender is already incarcerated or deceased” (2021, p. 5). Thomas described that “both [parents] struggled with depression for years” because “the key challenge became the ‘not knowing’;” their mother was “damaged ... in ways that you could never imagine;” his father was “able to tap into a reservoir of pain and anger all the way until his death at age 90;” and for the siblings, “those unanswered questions still weigh heavily on all of us” (2021, p. 6).

Though few will argue that survivors and family members of victims of these crimes, some decades old, have received some closure and justice, its use has raised ethical issues and concerns about consent, privacy, and confidentiality. The issues and concerns affect those individuals and their family members who submitted their DNA tests to databases like Ancestry, 23andMe, MyHeritage, FamilyTreeDNA, and GEDmatch. Additionally, issues and concerns have been raised concerning their rights to control their data and not become part of a law enforcement investigation.

This qualitative research study seeks to identify the perspective of genealogists on the use of IGG. Through interviews of genealogists, the study will examine their perceptions and knowledge of IGG, their opinions regarding areas of concern that have been raised, and whether they support its use to solve crimes. First, a review of the current literature will be presented to

introduce various subtopics that have emerged in research and discussions of IGG, some of which were addressed in the interviews conducted in the present study. These subtopics include a brief review of current forensic DNA techniques, the use of DNA in genealogy and law enforcement investigations, how IGG works, current policies and legislation regarding IGG, and concerns that have been raised. Next, the method section will outline the study's research design, participant recruitment process, data collection and analysis, and strengths and limitations of its research design. The study continues with the results section, which presents the four themes and two subthemes that emerged from the interviews. After the results are presented, the discussion section will place the study's results in the context of previous research, address the implications of this study and how it adds to the current research, specify limitations present in the study, and make recommendations for future research. In closing, the present study and its various sections will be summarized.

Literature Review

DNA analysis has been used in genetic testing to identify characteristics for diseases, to identify paternity, in studies of populations and human migration patterns, to identify the remains of famous historical figures like King Richard III and the Romanovs, in genealogy, and now, with IGG, by law enforcement to identify human remains and the perpetrators of various crimes (Katsanis, 2020). It is hard to dispute that IGG has transformed law enforcement investigations. Still, as noted by Callaghan (2019), before its use, best practices had not been developed and implemented to protect the privacy of those who have taken DNA tests to explore their ancestry, find family members, or uncover personal health information. Without the establishment of best practices regarding genomics, privacy, and law enforcement's use of genealogy to solve investigations, concerns have been raised that this new investigative tool could soon be severely restricted or forbidden, investigations could be compromised, and any public support for its use

could be jeopardized (Callaghan, 2019).

Research articles specific to IGG were published after the arrest of Joseph James DeAngelo Jr. in April 2018. Many describe the IGG process; identify ethical, privacy, and Fourth Amendment concerns, discuss the role of and effects on family members; review policies of DTC companies and genetic databases; and identify misconceptions about IGG and its use. Because the use of DNA by genealogists to conduct genetic genealogy can be traced back to at least 2002, and the use of DNA by law enforcement to solve crimes (without the use of genealogy) began in 1987, research articles published before April 2018 were also used in this study. The literature review will begin with a short discussion of DNA, how it is inherited and determines individual uniqueness, and some forensic DNA techniques. It will then provide further detail on how DNA has been used in genealogy and law enforcement and the existence of various genetic genealogy databases. The last three sections will focus on IGG, explaining how law enforcement began to use genetic genealogy and the IGG process, followed by some of the concerns in its use, and ending with mechanisms to decrease or mitigate such concerns.

Deoxyribonucleic Acid

Deoxyribonucleic acid (DNA), which is found in chromosomes, is the hereditary material that contains the biological instructions that make individuals unique (U.S. National Library of Medicine, n.d.-a). Four chemical bases make up the DNA code: adenine (A), guanine (G), cytosine (C), and thymine (T) (U.S. National Library of Medicine, n.d.-a). Everyone inherits one set of 23 chromosomes equally from each of his or her parents, resulting in 46 chromosomes that compose the entire genetic material in the human genome (Murphy, 2009; National Human Genome Research Institute, n.d.-a). The 23rd chromosome is the sex chromosome coded as XX for a female and XY for a male (Murphy, 2009). The remaining 22 chromosomes are called autosomes and do not determine an individual's sex (Murphy, 2009). The 23 pairs of

chromosomes containing an individual's DNA are found in the nucleus of one's cells, the basic building blocks of living things (U.S. National Library of Medicine, n.d.-a). The complete set of DNA is called a genome, and each DNA sequence that contains instructions to make a protein is called a gene (National Human Genome Research Institute, n.d.-a).

Because males carry the Y chromosome, only fathers pass Y-chromosome DNA (Y-DNA) from one generation to another, which, in genealogy, resembles the passing of a surname from father to son (Brown, 2002). Mothers pass mitochondrial DNA (mtDNA) to both sons and daughters. Chromosomes are made up of markers where short DNA sequences are repeated multiple times, with the number of repeats varying from one individual to another. Because an individual inherits one set of chromosomes from each parent, everyone has two copies of each marker (Arnaud, 2017). An individual's uniqueness or genetic signature results from one's unique patterns of slight variations or mutations as Y-DNA and mtDNA are passed from generation to generation (Brown, 2002).

DNA sequencing breaks down DNA to determine the order of the four chemical bases and helps scientists figure out the genetic information in each sequence (National Human Genome Research Institute, n.d.-b). Repeating sequences are found in many locations or loci within the human genome and are referred to as short tandem repeats (STRs). An individual's genetic profile can be created by identifying specific sequences at specific locations in the genome that repeat. Because of the variance in STRs across individuals and our inheritance of chromosomes from both parents, an individual's DNA profile can provide a high rate of specificity that identifies and differentiates individuals (Arnaud, 2017). One's genetic signature or haplotype refers to the set of markers found on a single chromosome inherited together (International Society of Genetic Genealogy [ISOGG], n.d.-a). Scientists have determined that two individuals share over 99.7 percent of identical DNA, and it is the remaining percentage that

contains enough variability to differentiate one individual from another (Murphy, 2009).

Forensic DNA Techniques

DNA fingerprinting, also known as DNA profiling, is a special technique conducted in a laboratory to detect variations in a DNA sample to produce a pattern unique to an individual (YourGenome, 2021). Through analysis and comparison, DNA fingerprinting or profiling can help establish identity, parentage, and family relationships and solve crimes and identify human remains (Smith, 2022). The most common form of DNA profiling is STR typing which looks at a specific number of locations or loci on one's genomic strand, measures the repeat lengths found on each pair of chromosomes, and counts each time a certain sequence repeats itself (Murphy, 2009). The locations of the repeat lengths found on each pair of chromosomes are known as alleles (Murphy, 2009). The inheritance of these alleles directly from one's biological parents makes two people who share biological ties have a higher probability of matches in their DNA profiles (Murphy, 2009). The degree of relationship or relatedness can be inferred by comparing specific patterns or distributions of alleles in the genetic profiles of individuals (Murphy, 2009). For example, if one were to look specifically at 13 loci, one would have 26 different measurements that differentiate one individual from another (Murphy, 2009). This kind of typing is also known as autosomal STR because it focuses on autosomal chromosomes (Murphy, 2009). As noted previously, autosomes are the 22 non-sex chromosomes, and autosomal refers to a gene located on a non-sex chromosome.

Because a Y-chromosome STR (Y-STR) focuses only on the Y chromosome, which males only carry, it is not found on DNA samples from females (Mittelman, 2021; Murphy, 2009). Y-STRs determine paternally derived relatedness and familial relationships among males, such as in paternity tests, and can identify relatives separated by two to four degrees (Mittelman, 2021, p. 9; U.S. National Library of Medicine, n.d.-b). Mitochondrial DNA (mtDNA) determines

maternally derived relatedness and traces one's maternal ancestry. It is passed unchanged from the mother to a child, whether female or male, but is not passed by the father to a child (Mittelman, 2021, p. 9; U.S. National Library of Medicine, n.d.-b). Researchers determine whether two people are distant relatives by comparing their Y-DNA or mtDNA markers (Brettell et al., 2005; Brown, 2002).

Single nucleotide polymorphisms (SNPs) occur throughout an individual's DNA, yielding more genetic data. SNPs are the most common genetic variation among people and have helped scientists locate genes associated with disease (Mittelman, 2021, p. 9; U.S. National Library of Medicine, n.d.-b). In addition, SNPs can identify an individual's ethnic background and more distant relatives with more reliability or accuracy (Mittelman, 2021, p. 9; U.S. National Library of Medicine, n.d.-b). As noted by Guerrini et al. (2021), SNP profiles provide genetic data that is "more evenly and (densely) distributed throughout an individual's genome." As a result, they can identify an individual's appearance, medical history, and distant genetic relatives (Guerrini et al., 2021).

Birth of Genetic Genealogy

According to the ISOGG, the first genetic genealogy tests offered to the public were by FamilyTreeDNA in May 2000 (ISOGG, n.d.-b). Brown (2002) described the 10th annual GenTech conference in Boston in early 2002 as one of the first introductions of DNA testing and analysis to genealogists through the exhibit booth of Oxford Ancestors and Relative Genetics. The United Kingdom-based Oxford Ancestors was founded by Bryan Sykes, a geneticist at Oxford University and the first scientist to recover ancient DNA from an archaeological bone in 1989 (Brown, 2002). By building a database of mtDNA samples provided by volunteers, Sykes subsequently isolated seven ancestral mtDNA sequences, attributing them to seven women he identified as the daughters of Eve and from whom 95% of Europeans descend. Sykes predicted

that “genetics [would] affect genealogy faster than any other field” (Brown, 2002, p. 1634). Sykes’ Oxford Ancestors advertised that for about \$220, one could find out from which of the seven daughters of Eve one was descended. One need only to take a swab of one’s cheek and mail it to Oxford Ancestors, where its scientists would compare one’s mtDNA to the seven ancestral mtDNA sequences. In addition to Oxford Ancestors, Brown (2002) identified FamilyTreeDNA, Relative Genetics, and GeneTree DNA as companies providing DNA tests as early as 2002.

Birth of Direct-To-Consumer Genetic Testing Services

The birth of direct-to-consumer (DTC) genetic testing services resulted from an adaptation of the tools population geneticists used to identify and study ancient human migration patterns, patterns traced using male lineages through the analysis of Y-DNA (Brettell et al., 2005; Brown, 2002). It also resulted from geneticists' tools to identify genes that carry certain diseases (Wolinsky, 2006). Individuals with certain diseases in their families provided their DNA and information from their family trees to geneticists to help identify genes that carry specific diseases (Wolinsky, 2006). Those tools were made available to consumers willing to pay for DTC genetic tests to identify and confirm biological relatives, make connections to specific groups or places, fill in gaps in family histories, identify genetic backgrounds, validate genealogical records, and develop meaningful narrative identities related to ancestry (Bolnick et al., 2007; Royal et al., 2010; Wolinsky, 2006). The expansion of DTC genetic tests to consumers resulted in the birth of DTC genetic testing companies, such as Ancestry, 23andMe, MyHeritage, and FamilyTreeDNA.

There were, however, early concerns with the level of analysis provided by DTC genetic testing services because the analysis was limited to too few markers in either the Y-DNA or mtDNA (Brown, 2002). A lower level of accuracy would lead to many people sharing DNA

profiles and an inability to determine how far or how close people shared a common ancestor (Brown, 2002). Additionally, mistakes or differences in data collection or interpretation by the different DTC genetic test services could also provide different results, as noted in the example of Thomas Robinson being identified as a descendant of Genghis Khan (Wolinsky, 2006). Using Oxford Ancestors, Robinson's Y-STR analysis matched seven of nine markers in Khan's genetic signature, but when Robinson used FamilyTreeDNA, FamilyTreeDNA analyzed additional Y-SNPs and noted he was not as closely related as the Y-STR analysis had indicated (Wolinsky, 2006). Specifically, there was no common ancestry with Genghis Khan within the past 30,000 to 40,000 years (Wolinsky, 2006). According to Bolnick et al. (2007), consumers were not fully aware of the limitations of DTC genetic tests, the potential misleading practices, misconceptions due to their commercialization, and the profound impacts on individuals and communities. They called for the scientific community to discuss the potential dangers and limitations of DTC genetic testing and for genetic and anthropological associations to develop policy statements. Three years later, Royal et al. (2010) warned that DTC genetic tests continued providing imprecise definitions and identifications and raising political, legal, ethical, social, and psychological concerns.

Nevertheless, Wolinsky (2006) predicted DTC genetic tests would continue to be popular due to the increasing interest and fascination with discovering one's ancestry. Eight years after Brown (2002) wrote about the 10th annual GenTech conference, Royal et al. (2010) confirmed the public's continued interest in DTC genetic testing as evident in the growth of DTC genetic testing companies to approximately 40 in various countries. Although advances had expanded the genetic and genomic information available to consumers, many continued to be interested in information specific to their maternal and paternal lines of descent to trace their lineage or family history (Royal et al., 2010).

Use of DNA in Law Enforcement Investigations

The first use of forensic DNA profiling in a law enforcement investigation was in 1987 in England when Colin Pitchfork was arrested for the rape and murder of two 15-year-old girls (Arnaud, 2017). The British geneticist, Sir Alec Jeffreys, had invented and developed genetic fingerprinting and DNA profiling a few years earlier and was asked to aid in solving the murders. Jeffreys linked both crimes by matching DNA samples from both crime scenes. As law enforcement collected blood and saliva samples from more than 4,000 men living in the area of the murders, one individual was overheard saying he had been asked to supply DNA for someone else. That someone else was Pitchfork, and once his DNA was analyzed, it was matched to the DNA samples from both crime scenes. Since the Pitchfork investigation first tested the use of DNA evidence to secure a conviction, DNA analysis has been described as the “gold standard” in forensic science methods (Arnaud, 2017; Tibbetts, 2020). It can be extracted from blood, semen, tissue, saliva, bone, and objects that have been touched or handled where skin cells have been left behind (Greytak et al., 2019). DNA evidence is used to solve crimes and can exonerate those who were wrongly convicted and reduce the risk of wrongful convictions.

Guerrini et al. (2021) summarized three ways DNA collection occurs in investigations, noting that the use of all three by law enforcement agencies in the United States is routine and lawful in investigations where there is DNA evidence. An individual voluntarily provides one, meaning it is provided with knowledge and consent (Guerrini et al., 2021). Two are involuntarily provided where either knowledge is present but not consent, or neither knowledge nor consent is present (Guerrini et al., 2021). If law enforcement obtains a DNA sample using a warrant or other legal process, knowledge will be present, but consent will be overridden (Guerrini et al., 2021).

The third instance where neither knowledge nor consent is given is the surreptitious

collection of abandoned DNA (Guerrini et al., 2021). The surreptitious collection often occurs when an individual who law enforcement is interested in obtaining a DNA sample from discards or abandons an item, such as a paper cup, a cigarette butt, or a straw, from which DNA could be extracted. Without letting the individual know, law enforcement surreptitiously collects that item to extract the DNA and obtain an involuntary sample of the individual's DNA. The surreptitious collection of abandoned DNA continues to be upheld by courts under the Fourth Amendment; however, challenges against its use continue to be filed (Guerrini et al., 2021). Guerrini et al. (2021) noted that law enforcement would conduct DNA testing to confirm a suspect as the perpetrator after surreptitious collection occurs, especially where the victim does not know the perpetrator and when DNA is the primary evidence to connect the suspect to the crime.

According to Shapiro and Reifler (1996), courts in the United States initially struggled with admitting forensic DNA analysis as evidence. In 1988, Florida was the first state to use DNA evidence to convict a criminal defendant and to subsequently have an appellate court uphold the admission of DNA evidence in the same case, *Andrews v. Florida*, 533 So. 2d 841 (Fla. Dist. Ct. App. 1988) (Shapiro & Reifler, 1996). At the federal level, the first case where DNA profiling was upheld was in 1990 in *United States v. Jakobetz*. According to Roth (2020), certain areas of DNA evidence admissibility are no longer controversial, such as matching certain kinds of DNA profiles; however, other areas are disputed, especially when new techniques are used. Additionally, Roth points out that other legal standards concerning general evidentiary procedures or admissibility standards are applied at trial in U.S. courts. Even if DNA evidence is admitted, it will likely be contested at trial by the opposing party.

Genetic Databases

At the 10th annual GenTech conference in 2002, Relative Genetics, another early DTC genetic testing company, drew blood from volunteers to build a genetic and genealogical

database. Relative Genetics' director envisioned it as a comprehensive database of people's DNA and genealogical histories, a "historical atlas of genetics," that would determine specific places and times for gene pools across populations (Brown, 2002, p. 1635). Those who ordered tests from Relative Genetics could choose to have their DNA and genealogical information included in the database. As early as 2002, Brown noted the fine line between academic projects and the business of DTC genetic testing. For example, as part of its Genographic Project, National Geographic (n.d.) started a research-related genetic database in 2005 to study human migration and conduct anthropological and historical research by collecting and analyzing DNA samples from various participants (Wolinsky, 2006). Medical biobanks are another form of genetic database that store biological samples containing DNA. Biobanks assist in medical research by allowing researchers to identify associations between diseases and gene variations and apply that knowledge to developing targeted treatments, diagnostic tests, and personalized medicine (Machado & Silva, 2015; Maschke, 2008).

Commercial Genetic Databases

The most popular DTC genetic testing companies that provide genetic tests and maintain their DNA databases are Ancestry, 23andMe, FamilyTreeDNA, and MyHeritage. According to Regalado (2019), these four databases contained DNA data from more than 26 million customers at the start of 2019. These DTC genetic testing companies sell DNA test kits that produce a large amount of high-quality DNA from a sole source, the consumer, through either a cheek swab or spitting saliva into a tube. DTC genetic testing companies extract and analyze DNA samples using SNPs to create DNA profiles that supply information about one's ancestry. In addition, some companies offer the ability to learn information about physical traits and health reports. SNP analysis identifies many loci in a DNA sample, making it a powerful tool for identifying even distant relatives.

To find relatives, the companies use an automated function to compare an individual's DNA profile with the DNA profiles of others in the database, which is commonly referred to as relative matching. A close relation or genetic relative is found when large stretches of identical DNA are found between samples. Unlike Ancestry and 23andMe, GEDmatch does not provide genetic testing services and is a public database that enables users to upload and compare their DNA raw data obtained from the various commercial DNA genetic testing services (Greytak et al., 2019; Kolenc, 2020; Tyack & Cline, 2019).

It is important to note that participants in these genetic genealogy databases are not given access to the SNP profiles of other participants regardless of identification as genetic relatives or not (Guerrini et al., 2021). Instead, they are provided a list of the genetic matches or genetic relatives that have been identified and other information that the match or genetic relative has chosen to share. In addition, Guerrini et al. (2021) noted that individuals can de-identify themselves by using pseudonyms or having someone else manage their accounts. Whether public or private, these are non-law enforcement databases owned by third-party entities where individuals voluntarily submit their DNA data after taking a DTC genetic test or by uploading their raw DNA data after taking a DTC genetic test. Additional information comparing Ancestry, 23andMe, FamilyTreeDNA, MyHeritage, and GEDmatch is summarized in Table B1.

Law Enforcement Genetic Databases

In the United States, the DNA Identification Act of 1994 authorized the establishment of the National DNA Index System (NDIS), a law enforcement DNA database at the national level (FBI, n.d.-b). Brettell et al. (2005) predicted that as law enforcement agencies continued to be successful in linking offenders to unsolved crimes using law enforcement or forensic DNA databases, there would be an increase in the number of DNA samples entered into forensic DNA databases. DNA profiles in forensic DNA databases are obtained from individuals who have

encounters with law enforcement and from unidentified DNA in unsolved crime scenes. Some law enforcement databases like NDIS also maintain DNA from unidentified human remains, missing persons, and relatives of missing persons (FBI, n.d.-b). Unlike commercial databases, which use SNP analysis, forensic DNA databases use STR analysis, which uses only 20 markers to build DNA profiles. These profiles are narrower in scope and can only directly match another DNA profile or partially match with a parent, child, or sibling.

As of October 2021, NDIS had more than 14,836,490 offender profiles, 4,513,955 arrestee profiles, and 1,144,255 forensic profiles and had generated more than 587,773 hits, aiding in more than 574,343 investigations (FBI, n.d.-a). In addition, individual states and local law enforcement agencies established DNA index systems at their levels, respectively called the State DNA Index Systems (SDIS) and Local DNA Index Systems (LDIS) (Katsanis, 2020). DNA profiles from all three systems are uploaded into CODIS, a software designed and kept by the FBI, which facilitates the sharing and searching of DNA profiles within and between jurisdictions across the U.S. to link crime scenes, identify potential serial offenders, and generate investigative leads (FBI, n.d.-c). Collectively, these databases are often referred to as CODIS.

Prainsack and Aronson (2015) describe seven criteria underlying forensic genetic databases that are established and managed across different countries, including the United States. The requirements for the inclusion and retention of DNA samples and profiles vary across jurisdictions (Prainsack & Aronson, 2015). In some jurisdictions, individuals must be convicted of a crime to include their DNA samples and profiles into a forensic DNA database (Prainsack & Aronson, 2015). In other jurisdictions, inclusion will occur upon being charged with a crime (Prainsack & Aronson, 2015). DNA samples and profiles are removed in some jurisdictions if not convicted, while in other jurisdictions, they remain in the database even if acquitted (Prainsack & Aronson, 2015). In addition to criteria for inclusion and retention of DNA samples

and profiles, there are also criteria identifying the set of genetic markers included in a forensic DNA profile (Prainsack & Aronson, 2015). In the U.S., this criterion is uniform across all three levels of DNA index systems (FBI, n.d.-b). Three additional criteria include: tendencies to expand the functions and purposes of DNA samples and profiles, who is responsible for and maintains custody of the forensic DNA database, and the kinds of laboratories used to perform the genetic analysis that results in the DNA profiles submitted to the forensic DNA databases (Prainsack & Aronson, 2015).

Use of Genetic Genealogy by Law Enforcement

Before IGG, two genetic genealogy techniques were available to law enforcement using DNA samples already in forensic DNA databases, such as the NDIS, SDIS, and LDIS databases. The two techniques, known as partial matching and familial searching, have been described as forensic genetic genealogy because leads are derived from the DNA profiles of relatives in a forensic DNA database. These techniques can be used in certain jurisdictions after law enforcement cannot obtain a DNA match by comparing the DNA profile belonging to the perpetrator of a crime to the DNA profiles in forensic DNA databases. For example, although law enforcement was unsuccessful in obtaining a DNA match to a known individual, the search could result in viable leads that identify a closely related biological relative but only if the relative's DNA profile is also in the forensic DNA database. In other words, the relative must have also had an encounter with law enforcement.

Partial matching occurs when a traditional search of an offender's DNA profile in CODIS results in a partial but not identical match to a sample DNA profile already in CODIS (FBI, n.d.-b). A partial match means that the offender could be closely related biologically to the sample DNA profile in CODIS (FBI, n.d.-b). Familial searching is conducted after a traditional search yields a negative result. The FBI describes it as a "deliberate search" to identify close biological

relatives at the sibling or parent/child relationship level, but it is only successful if the relative's DNA profile is in the law enforcement database (Bieber et al., 2006; FBI, n.d.-b). Familial searching is conducted after a traditional search yields a negative result.

In both kinds of searches, leads are prioritized based on the results, ranked by the degree of relatedness (Bieber et al., 2006). In 2006, Bieber et al. estimated that the rate of positive hits or cold hits could be improved by 40% using familial searching. In other words, they estimated positive matches between the DNA profiles in the forensic DNA databases and the crime scene DNA profiles could increase from 10% to 14%. Familial searching was used to identify, arrest, and prosecute serial killer Lonnie Franklin Jr., also known as the Grim Sleeper, when it yielded a partial match to Franklin's son, whose DNA was in CODIS due to a prior arrest (Katsanis, 2020; Murphy, 2009). Willing (2005) noted the use of familial searching in exonerating Darryl Hunt, who was wrongly convicted in the 1984 murder of Deborah Sykes. At the NDIS level, familial searching is not performed; however, at the SDIS level, certain states have authorized its use while others have prohibited it. Texas currently conducts familial searches.

Investigative Genetic Genealogy

IGG involves searching databases traditionally used for genetic genealogy and containing the genetic data of private individuals interested in learning more about their ancestry and family lineage and identifying unknown relatives. These are databases populated by regular individuals who have voluntarily taken DTC genetic tests offered by DTC genetic testing companies like Ancestry, 23andMe, FamilyTreeDNA, and MyHeritage or through individuals uploading their DNA data to public genealogy databases like GEDmatch. In other words, these are non-law enforcement databases. Therefore, the use of IGG expands the possibility for law enforcement to generate leads because IGG involves the searching of databases beyond CODIS to databases traditionally used for genetic genealogy and containing the genetic data of private individuals

(Guerrini et al., 2021). The identification, arrest, and successful prosecution of Joseph DeAngelo, the Golden State Killer, garnered much attention and further discussions about IGG. Callahan (2019) explained that a match or genetic association in one of these non-law enforcement databases to the crime scene DNA profile can generate an investigative lead by finding a relative in degrees of separation, whether close or distant. With the help of genealogists, a family tree can be built encompassing multiple generations and relatives to better understand the genetic association and identify a suspect.

In investigations where there is DNA evidence, the use of IGG does not replace or bypass traditional investigations or investigative techniques. When a crime has occurred, and there is DNA evidence, law enforcement does not automatically initiate the use of IGG. Instead, it focuses on investigating and solving the case by applying traditional investigative steps and techniques. First, an STR profile will be generated. Next, DNA will be collected either voluntarily or involuntarily from the suspect if there is a suspect and compared with the crime scene DNA profile. If it is a match, the investigation moves towards the prosecution phase and may involve additional corroborating evidence, such as eyewitness accounts, the timeline of the suspect's whereabouts and access to the crime scene, and possession of any weapon used (Guerrini et al., 2021).

If there is no suspect, the STR profile is uploaded into CODIS for a possible match. If there is a match with a CODIS profile, the law enforcement agency will be provided with the name of the matching offender already in CODIS and move forward towards prosecution with additional corroborating evidence. If there is no match in CODIS, law enforcement will apply other investigative techniques to generate leads. These techniques may include conducting interviews, accessing and reviewing surveillance footage, requesting assistance from the public via tip lines and working any leads generated from the public, ongoing collection and analysis of

the evidence as it is identified, conducting surveillance on suspects, and obtaining DNA samples, whether voluntarily or involuntarily, from suspects to generate STR profiles to directly compare to the STR profile of the crime scene DNA profile (Guerrini et al., 2021).

If traditional investigative techniques have been unsuccessful, the law enforcement agency may turn to IGG to generate additional leads. However, as Guerrini et al. (2021) noted, agencies must have the resources to be able to use IGG because the genealogy part of the IGG process is “expensive and requires specialized support” (p. 15). A private forensic laboratory generates an SNP profile of the crime scene DNA before it can be uploaded to any genetic genealogy databases (Guerrini et al., 2021; Katsanis, 2020). Next, the law enforcement agency will follow the current policies of genetic genealogy databases, which set forth for which crimes they will allow the crime scene DNA profile to be uploaded and which DNA data will be accessible to law enforcement within the genetic genealogy databases (Katsanis, 2020).

Currently, only GEDmatch and FamilyTreeDNA allow access to law enforcement without requiring legal process in investigations of violent crimes and to identify human remains. Still, the access is only to a subset of the entire database where individuals have consented for their DNA data to be accessible to law enforcement (Guerrini et al., 2021; Katsanis, 2020). Once the DNA profile is uploaded, it is compared across the DNA profiles that account holders have consented to be used in IGG. The database generates a list of matches or genetic relatives and their degree of relatedness to the crime scene DNA profile. This list and any other information associated with the account that the account holder has consented to be provided to law enforcement is shared with law enforcement (Guerrini et al., 2021). As noted in a previous section, the SNP profile belonging to matches on that list is not provided to law enforcement or the genealogists working with law enforcement. As stated by Guerrini et al. (2021), “the information that is useful to law enforcement conducting IGG is the estimated genetic

relatedness of participants to the offender and contact information for close matches, not any participant's SNP profile" (p. 9).

Investigators, genealogists, or both will search for information to initiate the building of family trees going back and then forward to identify possible kinship to a potential suspect in one of the genetic lines (Guerrini et al., 2021; Katsanis, 2020). To narrow down the number of genetic lines or branches, investigators may request DNA samples from relatives on those lines or branches to generate SNP profiles, compare them to the crime scene DNA profile, and eliminate certain genetic lines or branches (Guerrini et al., 2021). This process is called targeted testing (Guerrini et al., 2021).

When potential suspects are identified through genetic lines and traditional investigative techniques, additional research and investigative techniques may lead to new information that expands a family tree or eliminates specific genetic lines or branches (Guerrini et al., 2021). Once the list has been narrowed down to ideally one potential suspect, investigators will obtain a reference DNA sample to generate an STR DNA profile, either voluntarily or involuntarily. The STR profile will be compared to the original crime scene DNA profile uploaded into CODIS at the beginning of the process (Guerrini et al., 2021; Katsanis, 2020). If a match is confirmed, law enforcement will work with prosecutors to obtain corroborating evidence, arrest the suspect, and obtain a conviction. If there is no match, the individual is cleared as a suspect, and investigators and genealogists will continue investigating.

Concerns with Law Enforcement's Use of Genetic Genealogy

Regardless of the successes resulting from partial matching, familial searching, and now IGG, concerns have been raised about law enforcement's use of DNA, maintenance of forensic DNA databases, and genetic genealogy, in general, to solve crimes. As early as 2006, concerns, most notably about privacy issues, had been raised with law enforcement's use of partial

matching and familial searching and the maintenance of both forensic DNA databases and other genetic databases. Willing (2005) noted that people who are not related could have some of the same genetic markers, leading to misidentifications. Although law enforcement is prohibited from using DNA profiles in forensic DNA databases for non-law enforcement purposes, the retention of DNA profiles is still a controversial issue (Bieber et al., 2006). Genetic data to discriminate against and persecute certain groups has also been raised as a concern (Wolinsky, 2006). Wolinsky raised the possibility of governments acquiring genetic databases to identify and persecute minorities, noting Nazi Germany as a warning due to the ability to identify and differentiate ethnicities from the DNA samples and provide percentages of ethnicity.

Royal et al. (2010) identified a lack of quality assurance guarantees with DTC testing services and security vulnerabilities of genetic genealogy databases that could allow access to the DNA samples for their use in inappropriate ways as two important concerns. Royal et al. (2010) also identified concerns with the continuation or termination of the terms of data collection and privacy policies established when the customer purchased the DNA kit in instances where a DTC genetic testing company files for bankruptcy or is sold. Murphy (2009) raised concerns regarding accountability, racial discrimination, privacy, equality, and accuracy in familial searching.

Katsanis (2020) identified two primary concerns with familial searching, with one being that the CODIS database is overrepresented by nonwhite offenders leading to a high probability that minorities would be targeted at a higher rate. The second concern noted by Katsanis was the intrusiveness of targeting the relatives. However, Katsanis explained that most of the public seemed to be okay with the use of familial searching in violent crimes after the Grim Sleeper was captured.

Specific Concerns and Beliefs About Law Enforcement's Use of IGG

IGG use has received a lot of media attention, resulting in added scrutiny on the use of

genetic genealogy by law enforcement, leading to both positive and negative discussions (Plemel, 2019). Concerns raised with IGG are like those raised with partial matching and familial searching. However, the significant difference is that law enforcement is comparing crime scene DNA profiles to DNA profiles that are not part of a forensic DNA database maintained by law enforcement agencies. Greytak et al. (2018) identified the sensitivity of the information found in an individual's DNA and the control that one has over how that data is used as two significant issues surrounding IGG and the genetic privacy of those who have given their DNA samples through commercial DNA genetic testing kits. Guerrini et al. (2021) identified privacy concerns resulting from the difference in the genetic information found in forensic genetic databases and the genetic information found in genetic genealogy databases. The sources of the DNA profiles are different, as are the types of genetic information in the DNA profiles, due to the difference between STR-generated DNA profiles and SNP-generated DNA profiles (Guerrini et al., 2021).

Specific to genetic genealogy databases, others have raised issues with consent and transparency in addition to privacy issues (Hazel et al., 2018; Plemel, 2019). Hazel et al. (2018) described genetic investigations by law enforcement as haphazard and underregulated when they first began to be used. Regalado (2019) highlighted a similar privacy concern noted by Royal et al. in 2010 that users are at the mercy of companies making changes to their policies, user agreements, or terms of service, often without users' knowledge. Another privacy concern that may sound extreme is that IGG, and other related genomic tools, will lead to surveillance of Americans who have not committed a crime or taken a DNA test, but because of a relative who did take a DNA test, are now able to be found and brought into a criminal investigation (Tibbetts, 2020).

Guerrini et al. (2018) surveyed 1,587 individuals to assess the public's opinion on law enforcement's access to genetic genealogy databases and customers' information. They

formulated a 20-item survey, distributed it through Amazon Mechanical Turk, and restricted participation to individuals residing in the United States and 18 years of age or older. Most of their respondents were between 18 and 36 years of age, female, non-Hispanic White, and had never purchased a DTC genetic test or used genealogy websites (Guerrini et al., 2018). Most of the survey respondents supported the use of IGG by supporting law enforcement's access to genetic genealogy websites to obtain a list of genetic relatives and associated customer information (Guerrini et al., 2018). Of interest, 65% of their respondents supported law enforcement creating fake profiles on genetic genealogy websites to enable them to search for genetic relatives. The respondents' support significantly increased when specific crimes in which to use IGG were identified, such as violent crimes and missing persons (Guerrini et al., 2018). In comparing their respondents' opinions on law enforcement's access to information from individuals' social media accounts and cell phone records, Guerrini et al. (2018) found the same pattern as in their assessment of law enforcement's use of IGG.

Samuel and Kennett (2020) interviewed 45 members of the public and stakeholders, with all but one from the United Kingdom, to explore their views on IGG use. Their study's participants included "forensic scientists, representatives of DNA companies, criminal justice system members, policymakers, ethicists, academics, genealogists, and public users of genetic genealogy databases" (Samuel & Kennett, 2020, p. 2). Most of the participants in their study who used genetic genealogy databases were female, White, and over 40 years old (Samuel & Kennett, 2020). Samuel and Kennett found general support for IGG when solving "serious crime investigations" (2020, p. 6). In addition, they identified social and ethical concerns raised from their participants' answers and their thoughts on regulation. Samuel and Kennett categorized their results into four groups based on IGG's impact on individuals who use genetic genealogy databases and genetic genealogy and on genetic genealogy and law enforcement practices.

Samuel and Kennett (2020) acknowledged that policymaking and the continued use of IGG would rest heavily on public support. However, they argued that there should be a certain amount of wariness in the “support for IGG without interrogating the reasons behind this – reasons that may be related to a lack of information about the various risks of IGG and tied to this, unquestioning trust in law enforcement and the government” (Samuel & Kennett, 2020, p. 7).

General Concerns and Beliefs About Privacy

In 2019, the Pew Research Center published the results of its report, *Americans and Privacy: Concerned, Confused and Feeling Lack of Control Over Their Personal Information*, in which they surveyed a random selection of adults in the United States that make up the Pew Research Center’s American Trends Panel (n=5,869). 4,272 respondents provided answers. The report yielded two separate articles, Auxier et al. (2019) and Perrin (2020).

Perrin (2020) reported the results of the respondents’ answers to two questions regarding IGG: respondents’ use of DTC genetic testing services and whether they believed it acceptable, unacceptable, or were unsure about DTC genetic testing companies sharing the *genetic data* [emphasis added] with law enforcement to help solve crimes. Perrin (2020) found that 16% of respondents had used a DTC genetic testing service. In response to the question of law enforcement’s access, 48% of Americans responded that it was acceptable, 33% responded it was not acceptable, and 18% responded they were unsure (Perrin, 2020). In addition, Perrin (2020) found that households with higher incomes and older adults were more likely to use DTC genetic testing services. Fifty-one percent of respondents who had used a DTC genetic testing service and 56% ages 50 and older said it was acceptable for law enforcement to access the *genetic data* [emphasis added]. The researcher’s emphasis on ‘genetic data’ is to remind the reader of the point made by Guerrini et al. (2021) regarding how the language used to discuss the

IGG process matters. As noted in prior research, respondents may not know that law enforcement does not obtain raw DNA data in the IGG process but instead is provided a list of genetic relatives and their degree of relatedness to the DNA profile uploaded by law enforcement.

Auxier et al. (2019) broadly reported the results of the respondents' beliefs on privacy matters in the United States. They found that most Americans were more concerned about privacy issues and data control with companies than with the government (Auxier et al., 2019). Differences in views were influenced by age, race, and ethnicity on some privacy issues. Respondents ages 65 and older were more skeptical about privacy and how data was used, except, as noted by Perrin (2020), when it came to helping law enforcement solve crimes using genetic genealogy databases. Black and Hispanic adults were more skeptical about privacy across most scenarios (Auxier et al., 2019). When the survey was deployed in June 2019, most respondents believed personal data was less secure, and there were more risks than benefits with data collection (Auxier et al., 2019). However, variances existed when asked to answer questions about specific purposes where data would be shared, such as the questions regarding IGG (Auxier et al., 2019). Most felt they had little or no control over how companies and the government use their personal information and acknowledged their lack of diligence in paying attention to terms of service and privacy policies and lack of understanding of data privacy laws (Auxier et al., 2019). In instances of consumers' data misuse, most respondents were not confident the companies would be forthcoming, promptly notify users, or be held accountable by government entities (Auxier et al., 2019). Lastly, participants were most concerned with "the role other people and organizations can play in learning about them, their desire to shield their personal activities and possessions, and their interest in controlling who is given access to their personal information" (Auxier et al., 2019, p. 12).

Misconceptions in Law Enforcement’s Use of IGG

Guerrini et al. (2021) addressed four misconceptions about IGG that they have recognized from private conversations, online forums, and how it has been described in the media. Some of the misinformation, misconceptions, and misunderstandings are complicated when the understanding of the process and the technologies used is lacking, and the language used to describe IGG, such as using “genetic informants or witnesses” to describe “genetic relatives,” is “incorrect and promotes confusion” (Guerrini et al., 2021, p. 17). Similarly, Guerrini et al. (2021) identified a lack of differentiation between established processes and techniques involved in traditional and IGG investigations and between (non-law enforcement) genetic genealogy and IGG, underscoring these misconceptions. For example, surreptitious DNA collection is a routine investigative technique that has been used by law enforcement in traditional investigations for years before IGG began to be used, and its use has been challenged and upheld in the courts (Guerrini et al., 2021). In addition, relative matching is an automatic operation available to all participants in genetic genealogy databases to identify genetic relatives, not just for law enforcement (Guerrini et al., 2021). It is important to identify and address such misconceptions to avoid their potential to “confuse the public debate around IGG and lead to an adoption of policies intended to address concerns that do not reflect the current practice of IGG while misdirecting attention away from concerns that do” (Guerrini et al., 2021, p. 7).

Guerrini et al. (2021) identified the first misconception revolves around the belief that law enforcement is given special access to information about participants in genetic genealogy databases. As they note, access is often the same or more restrictive for law enforcement than other database participants, which is restricted by both the databases that are law enforcement accessible and in the kinds of investigations for which access is allowed. For example, some believe or assume that law enforcement will have access to participants’ SNP profiles, which is

not allowed for any participant of a genetic genealogy database, whether you are law enforcement or an individual conducting personal genealogy research (Guerrini et al., 2021).

The second misconception identified by Guerrini et al. (2021) is that the relatives of an individual whose DNA data is in a genetic genealogy database will be arrested by law enforcement solely due to them matching through shared DNA. In other words, “participating in genetic genealogy databases is the equivalent of ratting out one’s criminal relatives” because individuals whose DNA data is in the databases are now “genetic witnesses” or “genetic informants” (Guerrini et al., 2021, p. 10). IGG generates leads for law enforcement, who must apply traditional investigative techniques to corroborate evidence and solidify the probable cause needed to obtain an arrest warrant and a successful conviction.

The third misconception was that many innocent people would have to provide DNA samples in investigations that use IGG versus traditional investigations involving collecting, testing, and analyzing DNA (Guerrini et al., 2021). The underlying concern was that “such testing constitutes an invasion of privacy that undermines the ethical acceptability or even lawfulness of IGG” (Guerrini et al., 2021, p. 12). However, as Guerrini et al. (2021) indicated, in resolving traditional investigations with DNA as evidence, investigators will have to collect DNA samples from potential subjects to clear them of suspicion and identify the true perpetrator. Additionally, they identified the potential for IGG to reduce the number of DNA samples collected from numerous innocent individuals by narrowing down the list of potential suspects from whom to collect and test DNA samples through the leads generated from the relative matching function available in genetic genealogy databases (Guerrini et al., 2021). Finally, the fourth misconception identified by Guerrini et al. is that IGG is already or will be used to solve every crime and has been described as a “dystopian tool for state surveillance” (2021, p. 15).

Allaying Concerns

Regarding concerns of misidentifications, DNA technology continues to improve, allowing for more detailed analysis of DNA samples and identification of similar markers. Additionally, for law enforcement to arrest a suspect linked to an unsolved crime, a direct match must be made between the suspect's DNA profile and the crime scene DNA profile. Even at the start of consumers' involvement in commercial DTC genetic testing, Wolinsky (2006) noted that private DTC genetic services like FamilyTreeDNA used bar codes to identify DNA samples instead of the customers' names to protect their identity. In addition, FamilyTreeDNA gave its customers options to consent to have their DNA samples destroyed or stored for future testing (Wolinsky, 2006). In the early years, court challenges against the use of DNA by law enforcement focused on using forensic DNA databases, collecting DNA samples, and expansions in the categories of individuals from whom DNA samples would be collected (Bieber et al., 2006). These challenges have not prevailed because support for the public's safety has overridden individual privacy interests.

Greytak et al. (2018) identified four important points to mitigate concerns about control of one's genetic data and the sensitivity of its information. First, law enforcement had to use legal process to compel private DTC genetic testing companies to participate in law enforcement investigations because they do not do so voluntarily. Only public databases like GEDmatch were searched because individuals had chosen to make their DNA profiles available by uploading them to GEDmatch (Greytak et al., 2018; Hazel et al., 2018). Second, individuals were not required to contribute DNA profiles to commercial and public genetic genealogy databases, unlike forensic DNA databases, so the government does not possess those DNA profiles (Greytak et al., 2018). Third, law enforcement did not have access to one's raw genetic data, containing sensitive, personal, and health-related information (Greytak et al., 2018). The search results provided to law enforcement contained the degree of kinship among individuals, not the

raw data associated with the matching DNA profiles (Greytak et al., 2018). The fourth point made by Greytak et al. (2018) was that IGG generated leads for law enforcement that could then lead to arrests and convictions. For the individual or person of interest to continue being investigated, arrested, and convicted, a direct DNA match must be made between that individual's DNA profile and the crime scene DNA profile.

According to Greytak et al. (2019), the databases of AncestryDNA and 23andMe were not accessible by law enforcement because both companies require samples to be submitted through either a spit kit or a cheek swab. In addition, although MyHeritage and FamilyTreeDNA allowed uploads of DNA data derived from other sources, such as AncestryDNA and 23andMe's kits, they required law enforcement either provide a court order or legal documentation requesting permission to upload a DNA sample into either database (Greytak et al., 2019). However, law enforcement could upload profile samples to GEDmatch, and its users had been advised of law enforcement's use of the database to identify human remains and the perpetrators of violent crimes (Greytak et al., 2019).

Policies and Procedures

Another way to mitigate concerns is by implementing policies and procedures that law enforcement must follow when using IGG. In November 2019, the U.S. Department of Justice (DOJ) approved an interim policy at the federal level that put in place policies and practices to protect privacy interests while allowing for the effective use of IGG to help identify violent criminals, exonerate innocent suspects, and administer justice fairly and impartially (DOJ, 2019). The DOJ interim policy applies to DOJ agencies, investigations, employees, contractors, and any non-DOJ criminal investigation or agency that receives funding from DOJ to conduct IGG. It sets forth that before any attempt is made to use IGG, the law enforcement agency must conduct a CODIS search of the perpetrator's DNA sample left at the crime scene. IGG can be used if that

results in a negative DNA match and all reasonable investigative leads have been exhausted.

The DOJ interim policy restricts the use of IGG to specific cases, namely unsolved violent crimes, such as homicide or sexual offenses, and in the identification of human remains. However, it gives discretion to the prosecutor with authority over the crime or the location of the unidentified human remains to authorize the use of IGG for criminal acts whose circumstances present a substantial and ongoing threat to public safety or national security. In addition, it places restrictions on how investigative agencies communicate with and access public genetic genealogy databases and DTC genetic genealogy services. It directs agencies to disclose that they are law enforcement and restricts access to genealogy databases that disclose to their users that law enforcement may use the databases to investigate crimes or identify human remains.

Any reference DNA samples obtained from individuals identified as third parties that were not the original match found in the genetic genealogy database must be obtained lawfully and through informed consent provided by the third-party individual. When notifying the third-party individual could compromise the investigation's integrity, the prosecutor must be consulted and must provide approval before any attempt is made to obtain a covert or surreptitious reference DNA sample. Law enforcement must obtain a search warrant when a reference DNA sample is obtained covertly before a vendor laboratory conducts the analysis. The DOJ interim policy is explicit in forbidding the use of any profile sample to determine psychological traits and any health-related information. It sets guidelines for the control, documentation, and disposition of all profile samples, service accounts, and data at distinct stages of an investigation.

Although DOJ's interim policy guidance is at the federal level, it is expected that state and local law enforcement and prosecuting agencies will establish their policies and procedures regarding IGG use. As an example, the Sacramento County District Attorney's Office (n.d.) instituted a memorandum of understanding between itself as the prosecuting agency and the law

enforcement or investigative agency that implemented policies and procedures for IGG use. It follows many of the guidelines set forth by the DOJ interim policy. In addition, forensic DNA advisory groups, such as the Scientific Working Group on DNA Analysis Methods, have provided added guidance. The Scientific Working Group on DNA Analysis Methods published guidance similar to DOJ's interim policy in February 2020.

The U.S. Constitution and Court Challenges

Concerns associated with the genetic privacy of those who give their DNA samples through commercial DNA genetic testing kits and law enforcement's access to the resulting DNA profiles have led to discussions of the use of IGG as it relates to the Fourth Amendment's protection from unreasonable searches by the Government. These discussions have also included the Supreme Court's decision in *Carpenter v. United States* (2018) and what Associate Justice Anthony Kennedy wrote in his dissent. In *Carpenter v. United States* (2018), the Supreme Court ruled that the FBI's acquisition of cell-site records was a Fourth Amendment search. Thus, the Government (i.e., the FBI) had violated Carpenter's right against unreasonable searches and seizures. In its ruling, the Supreme Court noted the privacy concerns raised by the extent of information provided by historical cell-site records. In his dissent, Associate Justice Kennedy identified the factors used in the Court's application of the reasonable expectation of privacy test as "intimacy, comprehensiveness, expense, retrospectivity, and voluntariness" (*Carpenter v. United States*, 2018, as cited in Kolenc, 2020). Although cell-site records are created and maintained by wireless carriers as business records, the Supreme Court did not apply the third-party doctrine in its decision noting the data is extensively revealing of one's location, the use of cell phones is indispensable to participation in modern society, and the logging of cell-site records results from simply turning on the cell phone (Kolenc, 2020).

In applying the same five factors used in *Carpenter v. United States* (2018) to analyze

whether there is an expectation of privacy in an individual's DNA test results, Kolenc (2020) found that all but the fifth, voluntariness, apply. Unlike the indispensable need to carry a cell phone to be part of society, there is a higher degree of voluntariness when an individual provides his or her DNA to a DTC genetic testing company. According to Tyack and Cline (2019), individuals who willingly provide their DNA material to a DTC genetic testing company or upload their DNA profiles to a public genetic genealogy website are *generally* assumed to have waived the protections and rights afforded by the Fourth Amendment against warrantless searches and seizures. In addition, Tyack and Cline (2019) noted that those individuals who voluntarily upload their DNA profiles to public genetic genealogy databases like GEDmatch, where it is known that the information will be shared publicly, have effectively given their information to a third-party entity.

However, they differentiated with genetic genealogy databases maintained by companies like Ancestry and 23andMe that do not publicly share information and suggested that law enforcement would need to obtain a warrant to search those companies' records (Tyack & Cline, 2019). Kolenc (2020) noted that sites such as Ancestry and 23andMe have resisted law enforcement requests for data but acknowledge they may be required to comply if served with a court order, subpoena, or search warrant. In addition, the public genealogy sites that have cooperated with law enforcement, such as GEDmatch and FamilyTreeDNA, have updated their policies to increase their customers' privacy rights and have restricted access to their databases by law enforcement to specific types of crimes (Kolenc, 2020).

Legislation

Another means to mitigate concerns about the use of IGG is to pass legislation at the federal and state levels. Maryland and Montana became the first U.S. states to pass laws regulating IGG use by law enforcement agencies (Taylor, 2021). Some states have not passed

laws regarding IGG use but have passed laws tightening regulations on DTC genetic testing companies concerning consumers' rights to consent and control of their genetic sample and data, data security, and privacy rights (Mullin, 2021). These states include California, Utah, and Arizona (Mullin, 2021). As of March 2022, no policies have been found that outline the use of IGG by Texas law enforcement and prosecuting agencies or any indications of legislation introduced to the Texas Legislature regarding IGG.

As the evolution of investigative techniques has shown us, there will always be challenges to balancing privacy rights and protections with emerging investigative tools and techniques. For example, Bieber et al. (2006) noted that limiting the use of genetic genealogy by law enforcement to the most serious offenses could limit the opposition to its use. Still, they found that further evaluation of legal, ethical, and policy implications should be done in conjunction with assessing its potential value added to investigations. Likewise, Kennett (2019) noted that the public's safety and a victim's right to justice must be balanced with everyone's privacy rights regardless of who has or has not taken a DNA test because an individual's DNA will always link them to others. Often, this balance results from legislation and challenges in court.

Universal Genetic Databases?

Hazel et al. (2018) and Plemel (2019) suggested the implementation of a universal database that contains the DNA profiles of every member of society. A universal genetic database would remove the need for separate research, commercial, and forensic DNA databases. Both argue that a universal database could be more productive, less stigmatizing, and less discriminatory because everyone would be represented. In addition, access to a universal genetic database could solve crimes quickly and with fewer resources, fewer misidentifications and wrongful convictions, and human remains being identified quickly (Hazel et al., 2018; Plemel,

2019).

A universal genetic database would obviate the use of IGG, and innocent relatives of perpetrators would not come to the attention of law enforcement when trying to solve a crime (Hazel et al., 2018; Plemel, 2019). There would still be restrictions and regulations on who accesses this data and how it is accessed. For example, law enforcement would only be able to use the database to investigate serious crimes and use a search warrant (Hazel et al., 2018). Legislation would be enacted to establish an independent agency to run the database and require the destruction of the physical DNA samples after a DNA profile has been generated to avoid the misguided use of one's biological information (Hazel et al., 2018). Noting that privacy concerns may still be raised, Hazel et al. (2018) proposed that a universal genetic database may not compromise as much privacy as all the current, separate databases.

Methods

In the IGG process, genealogists provide the expertise to trace family lineages, build family trees, and identify potential suspects after receiving the results or matches obtained from comparing crime scene DNA profiles to the DNA profiles in the genealogy databases. They provide leads to law enforcement officers in the form of names of potential suspects. The present qualitative study aimed to examine genealogists' perceptions and knowledge of IGG, their opinions regarding areas of concern that have been raised, and whether they support its use to solve crimes. By interviewing genealogists, the researcher sought to identify concerns and misconceptions that could also be held by the public, impeding wider support for its use. Knowing these concerns and misconceptions could lead to informed policymaking and campaigns to educate the public if IGG is a technique that law enforcement endeavors to continue using. This section addresses the study's research design, participants, participant recruitment process, data collection and analysis procedures, and the strengths and limitations of

the study's research design.

Research Design

This study employed a qualitative research design using in-depth interviews to initiate conversations with genealogists on the topic of IGG. The interviews followed a semi-structured design with questions that captured demographic data, experience in genealogical research, and opinions about topics specific to IGG. The semi-structured interview design included open-ended questions, which resulted in interviews that felt like conversations and provided flexibility to explore responses with follow-up unscripted questions and themes not previously identified. This interview style contributed to the study participants feeling at ease and providing honest and in-depth answers. This qualitative interview style closely mirrored the interview preparation and data logging suggestions presented by Lofland et al. (2006). After transcribing the interview recordings and the researcher's handwritten notes, thematic analysis and narrative analysis were applied to identify themes by analyzing and categorizing the data.

Participant Recruitment

The study participants included the researcher and the genealogists who were interviewed. The researcher and the genealogists had different levels of knowledge and experience regarding genealogy, the most popular public and private genealogical databases, and the IGG process. The researcher considers herself an amateur genealogist who began her pursuit of uncovering more details of her family's history approximately seven years ago. Additionally, the researcher has submitted DNA kits for herself and both her parents to a private DTC genetic testing service. The researcher has maximized privacy and confidentiality controls in her account as provided by the DTC genetic testing service. The researcher has also been a law enforcement officer for 18 years and works for an agency that has used genetic testing to solve crimes but has not been involved in the use of IGG.

Participant Selection

It was important to identify study participants who identified themselves as genealogists regardless of whether they had used IGG or not. Their insight and perspective are valuable because the IGG process involves genealogists and law enforcement officers. Genealogists who have not used IGG still have experience in the methods used in the IGG process, such as tracing family lineages, building family trees, and identifying potential matches identified using genetic genealogy. Their perceptions and degree of knowledge of IGG would still provide valuable data to identify concerns and misconceptions that the public could also hold.

Three websites with information on genealogists and genealogical societies in Texas were used to initiate the purposive sampling. A preliminary search on the Association of Professional Genealogists website, using Texas as the state of residence, yielded 76 results. The website Board of Certification of Certified Genealogists yielded 10 results, of which two were also found through the previous website. Contact information and further information about each genealogist were also available through this second website. A third website, Texas State Genealogical Society, provided a list of every known genealogical society in Texas, their location, and further contact information. All websites provided an email address for contact, whether the address was for the genealogist or the genealogical society. The researcher initially focused on genealogists with associations to Texas and residing in the Dallas-Fort Worth metroplex to maximize the opportunity for face-to-face interviews. However, due to the limited responses in the first recruitment wave, the researcher broadened the scope to genealogists outside the Dallas-Fort Worth metroplex. The researcher identified nine genealogists and 35 genealogical societies from whom to request participation in the present study.

Sampling Method

The present study employed a nonprobability sampling strategy as it was the best strategy

to use due to its qualitative research design, time and cost constraints, and a lack of knowledge of the number of elements of the complete population of genealogists. Maxfield and Babbie (2016) explained sampling as how researchers select what will be observed, a critical aspect of conducting research. Although nonprobability sampling is less reliable and less statistically representative, it is used in most research studies. The present study used two kinds of nonprobability sampling to identify genealogists: snowball sampling and purposive sampling.

In snowball sampling, the researcher relies on either one subject or a small number of subjects to identify the additional subject(s) who may be willing to participate in the study. Maxfield and Babbie (2016) described this method of identifying subjects as resulting “through chains of referrals” (p. 166). In this study, snowball sampling allowed the researcher to rely on the social networks of initial respondents to identify additional participants for the study and obtain an adequate sample size. To initiate the snowball sampling to identify genealogists, the researcher asked participants to use their social/professional network to identify additional genealogists the researcher could contact. Some participants identified through their membership in genealogical societies indicated they had encouraged others to participate or had themselves been encouraged to participate.

The second type of sampling employed was purposive sampling, which is driven by the researcher’s judgment and purpose of study in selecting a sample. In this type of sampling, the researcher identifies and selects experienced or knowledgeable subjects about the research topic to participate in the research study. It was important to the researcher to obtain experiences and opinions of the use of IGG from genealogists because they are part of the IGG process. Using purposive sampling, two participants who have helped law enforcement use IGG to solve cases were identified by two acquaintances of the researcher. Purposive sampling was the most appropriate method to identify genealogists who have used IGG because of the limited number

of cases that have been publicized in the researcher's location. The three websites and the known genealogists provided the researcher with a good starting point to build a workable sample of genealogists to interview.

A sample recruitment social script was sent via email detailing the eligibility requirements for the study subjects, the focus of the study, and the researcher's contact information. The recruitment emails were sent after the researcher received approval from the IRB. Participants did not receive payment or compensation or incentives for their time and effort in participating in the present study. Participation was voluntary, and any participant was allowed to withdraw, including requesting his or her information be withdrawn after the interview, without penalty or negative consequences. The participant could withdraw by communicating such a decision to the researcher, by not responding to further contact from the researcher, or by not participating in a predetermined interview. To minimize the possibility of undue influence or coercion from peers or supervisors, the researcher used her TCU email account and phone number to communicate directly with participants who volunteered to participate in the study using the method of communication preferred by each participant.

Of 10 genealogists who were asked to participate in the present study, eight (n=8) agreed to participate and formed the study's research sample. Of the two who did not participate, one immediately indicated they were too busy, and a second became unavailable after agreeing to participate. Of the eight who participated, three (n=3) were identified by acquaintances of the researcher, and the remaining five responded to the researcher's recruitment email. The process used to collect the data is discussed in the next section.

Data Collection

Semi-structured interviews, centered around a framework of themes, were used as the data collection tool. Some questions were scripted or structured, while other questions were

open-ended to allow the researcher to ask follow-up questions for a more in-depth understanding of the participant's answer or point of view. The interview script assisted the researcher in staying on point during the interview and communicated the researcher's professionalism, preparedness, and belief in the study to the study participants. The interview scripts included questions that touched on themes identified through the researcher's literature review, including issues and concerns. However, the interview script allowed for flexibility to ask follow-up questions and explore additional subtopics.

In designing the interview questions, the researcher followed the guidance provided by Maxfield and Babbie (2016) to avoid potential issues such as the study participants misinterpreting a question, feeling coerced in answering a certain way, or not wanting to answer a question based on its wording. The researcher focused on making questions clear, short, and grammatically correct to increase the study participant's understanding of the question, elicit reliable answers, and help the interview flow. Leading questions were not used to avoid study participants feeling a need to respond or agree in a certain way. Questions that asked more than one question, also known as double-barreled questions, were separated to avoid confusion and partial answers and minimize any problems with the reliability and validity of questions.

An additional consideration in the design of the interview script was the ordering of the questions. In interviews, unlike surveys, it is recommended to start with demographic questions, which often help build rapport and set a positive tone for the rest of the interview (Maxfield & Babbie, 2016). Questions were grouped thematically, with themes presented logically to build upon previously presented themes. For example, instead of immediately asking about IGG, questions were first asked about genealogy, in general, to understand the study participant's knowledge and experience with genealogy before asking about IGG as a more specific type of genealogy. Although no sensitive questions were included in the interview scripts, there was a

possibility that a sensitive topic could be discussed. For example, participants could share that they had been a victim of a violent crime, such as rape; had a family member or close friend who was a victim of a violent crime was, including homicide; or had a family member or close friend who disappeared and whose whereabouts remained unknown.

The interview instrument was divided into five sections (see Appendix). The first section asked five demographic questions to capture age, gender, race or ethnicity, highest educational level, and academic degree. The second section asked six questions that assessed each participant's experience and interest in genealogy, including whether they considered genealogy as their career, their start in genealogy, length and kind of experience in genealogy, and level of expertise. In addition, this section included a question about their acquaintance with law enforcement officers since IGG is a technique that requires collaboration between genealogists and law enforcement officers. The third section focused on five questions that assessed each participant's knowledge and support of IGG, including questions about the benefits and risks of using IGG and whether it should only be used in specific crimes or cases. The sixth question in this section asked each participant whether they had used IGG. The fourth section asked four questions about the areas of concern in using IGG identified during the researcher's literature review. These concerns included: privacy rights and confidentiality of DNA test-takers and their family members who had not tested, consent and control of an individual's genetic data, and misuse and misidentification. Finally, this section asked participants to provide a message to the public about IGG from their perspective as a genealogist and suggestions of how the public's support could be gained for IGG. The fifth and last section of questions asked each participant to add anything that may not have been discussed, for their preferred method of contact for any follow-up questions, if they wanted to be informed of the study results, and if they had any questions regarding the study.

All interviews were voluntary, and their setting, date, and time were at the preference of the study participant. Before initiating any interview, the researcher presented each participant with a consent form. The consent form included more details about the study, participation, risks, procedures to withdraw, confidentiality protections, additional matters concerning human subject research protocols, and consent to audio record the interview. Those that did not provide consent to be audio-recorded were still interviewed, with the researcher relying on interview notes for the data analysis. Only one participant chose not to be audio-recorded.

Although the preferred method to conduct the interviews was in person, consideration was given to conducting some interviews over the phone or using a video-conferencing service. During most of the present study's time frame, the COVID-19 community level in North Texas communities was deemed high. As a result, only two interviews were conducted in person. For in-person interviews, the participant decided on the interview location with attention to minimizing interruptions and maintaining confidentiality. Both in-person interviews (n=2) were conducted in public venues and audio-recorded. Five interviews (n=5) were conducted over the phone at the preference of the interviewee, of which four (n=4) were audio-recorded, and one was not audio-recorded. One interviewee responded by returning written answers, which was most convenient for the participant. Three interviewees (n=3) lived further than four hours away from the researcher, making a phone interview or written response the best choice.

During the formulation of the interview schedule and the execution of the interviews, the researcher was aware of any potential undue influence her interest in genealogy and law enforcement career could have in both the structure of the questions and the interviewing process. As a result, the researcher avoided question structure that was biased and leading and instead focused on writing them as open-ended questions, which allowed for follow-up. In addition, in the one interview that was not recorded, the researcher ensured her notes matched

what the interviewee answered to avoid bias or commentary from the researcher.

The researcher transcribed all recorded interviews and notes. Recorded interviews (n=6) lasted an average of 36 minutes; however, the longest interview, which was not recorded, lasted at least an hour. The shortest recorded interview lasted just under 23 minutes. The median duration of the recorded interviews (n=6) was just under 35 minutes. Because an eighth participant provided a written response, it did not have a duration as the in-person and phone interviews. Each interview included only the researcher and the participant to minimize any possibility of undue coercion or influence. The researcher conducted the phone interviews alone to minimize interruptions and maintain confidentiality. Participants were reminded of their voluntary participation, the minimal risks of their participation, the absence of any compensation, the ability for them to decline and withdraw their participation and data at any time before the publication of the study, and whom to contact regarding the study or concerns as a study participant. No participants withdrew from the study.

To prevent and minimize risks to privacy and/or confidentiality, including the potential for a data breach, only the researcher involved in the present study had access to the participants' information and interview responses (researcher's notes, audio, and transcripts). The researcher was the sole interviewer and did not identify participants with anyone else. For the audio-recorded interviews, the recorded part of the interview began after the demographic questions were asked to further maintain the privacy and confidentiality of all participants. A Sony digital recorder with a stereo microphone was used for all audio-recorded interviews. Participants were assigned a sequential code that began with the letter G and a number. Their codes were used as part of the file names of the audio recordings and transcripts. All digital data was saved and stored on a password-protected computer. Only the researcher involved in the present study or others who needed to review the study's information had direct access to the digital and physical

data. The process used to analyze the collected data is discussed in the next section.

Data Analysis

The researcher chose to transcribe all recorded interviews and interview notes verbatim, which included the participant's use of pauses and filler words. The researcher noted how participants expressed themselves and if they provided any stories. All transcripts were double-checked before using thematic analysis and narrative analysis to analyze the data. Thematic analysis is a common form of qualitative analysis in which the researcher searches for and identifies common patterns or themes among respondents in the sample (Vogt & Johnson, 2015). Narrative analysis tells respondents' stories and holds these qualitative accounts together by themes (Vogt & Johnson, 2015). Once the transcripts were finalized, the researcher analyzed and organized the data for common patterns and differences in the participants' answers, referencing the topics and specific questions from the interviews. The common patterns were identified from recurring words, ideas, concepts, and themes. Next, the researcher coded and categorized the responses to identify themes by color-coding text and using tables to compare common patterns across participants and in response to the interview questions. The researcher developed and maintained a consistent and systematic process to ensure quality data and accuracy. Microsoft Word was the primary word processor for data storage and analysis. The next section will address the strengths and limitations of the study's research design.

Strengths and Limitations of Methods

Using a qualitative research method and nonprobability sampling present both strengths and limitations. The qualitative data collected using a qualitative research method is typically higher in validity than quantitative data because study participants can explain their viewpoints, and the researcher can ask follow-up questions (Anderson, 2010; Maxfield & Babbie, 2016). The data is based on human experience, making it "powerful and sometimes more compelling than

quantitative data” (Anderson, 2010, p. 2). Qualitative interviews are based on a “deliberate plan but are inherently flexible” (Maxfield & Babbie, 2016, p. 196). This flexibility and the ability to examine topics in detail and depth are two strengths of using a qualitative research method (Anderson, 2010). Lastly, the interaction between the researcher and the participant can lead to identifying complexities and subtleties regarding the topic that would not be discovered using a quantitative research method (Anderson, 2010).

A limitation in using a qualitative research method may emerge in the strength of the data if study participants were not at ease, did not take the appropriate time to answer questions, and could not articulate well, thought-out, comprehensive answers during the interviews. Interview questions that are not formulated correctly and do not measure a study’s research question adequately can lead to issues of measurement validity (Maxfield & Babbie, 2016). In using a qualitative research method, a study’s reliability could be weakened due to a lack of standardization and factors that cannot be controlled in the data gathered, such as the varied experiences and answers provided by the study participants and the effect of the researcher’s presence on the participants’ responses (Anderson, 2010). Another limitation is that the quality of the research relies too heavily on the researcher’s skill and ability to interpret the qualitative data derived from interviews with as little subjectivity and bias as possible (Anderson, 2010).

Nonprobability sampling is an ideal strategy to use when a population is very large and randomization is impossible or when the researcher focuses on a specific element of a population such as genealogists (Etikan et al., 2015). Because nonprobability sampling is convenient and cost-efficient, it is an ideal sampling strategy when the researcher has limited time and resources (Etikan et al., 2015). However, the lack of generalizability due to sample selection and size issues is a limitation in using nonprobability sampling. The researcher cannot generalize the results to an entire population with confidence due to subjectivity. The researcher “does not give

all the participants or units in the population equal chances of being included” (Etikan et al., 2015, p. 1). Finally, nonprobability sampling increases the likelihood of bias and the inability to estimate sampling error.

Results

This qualitative study sought to examine genealogists’ perceptions and knowledge of IGG, their opinions regarding areas of concern that have been raised, and whether they support its use to solve crimes. After receiving the results or matches of genetic relatives generated from comparing crime scene DNA profiles to the DNA profiles in genetic genealogy databases, genealogists assist law enforcement in tracing family lineages, building family trees, and identifying potential suspects. Therefore, genealogists are critical components of the IGG process where law enforcement lack genealogy skills and expertise. In addition, the public likely holds concerns or misconceptions genealogists may have regarding IGG use, especially those who have never done genealogy research as a hobby. From the eight interviews conducted by the researcher, four themes and two subthemes emerged that met the goals of the present study. After a brief review of the additional characteristics of the participants, this section will provide the results of the eight interviews grouped by the four themes and subthemes. These include benefits and risks in using IGG, including concerns with misuse and misidentification; support for IGG; opinions regarding consent, privacy, and confidentiality; and thoughts regarding public awareness of the use of IGG.

Characteristics of Participants

Of the eight participants (n=8) who formed the study’s research sample, three participants (n=3) indicated genealogy was their career, which matched the number who described themselves as professional genealogists. The participants had an average of 27 years of experience in genealogy. Six participants (n=6) knew at least one law enforcement officer. Two

participants (n=2) had used IGG. All participants (n=8) had obtained at least one undergraduate degree, with four participants (n=4) who had either completed or were completing a graduate degree at the time of the interviews. Table 1 provides details of the participants' characteristics.

Table 1

Participant Characteristics (n=8)

Variable	Number of Participants
Age	
70-79	3
60-69	1
50-59	4
Gender	
Female	7
Male	1
Race/ethnicity	
White	6
Black	2
Highest academic degree	
Undergraduate	3
Professional Certification	1
Graduate	4
Genealogy as career	
Yes	3
No	5
Years of experience in genealogy	
5-9	1
15-19	2
20-24	1
25-29	2
40-44	1
55+	1
Expertise level in genealogy	
Amateur	2
Intermediate	3
Professional	3
Knows law enforcement officer	
Yes	6
No	2
Has used IGG	
Yes	2
No	6

Table 2 summarizes the participants' educational degrees across various academic fields of study in the humanities and social sciences, professions and applied sciences, and formal sciences. At the time of this study, one participant was enrolled in a graduate degree program in criminal justice. The remaining participants (n=7) had not attained a degree or certification in criminal justice or criminology.

Table 2

Professional Background of Genealogists (n=8)

Academic Field of Study
History/Political Science/Education
Psychology/Social Work
Anthropology/Public Administration/Criminal Justice
Business Administration
Agricultural Journalism
Sociology/African American Studies/Education
Nursing
Computer Science/Library Sciences

Table 3 summarizes the participants' initial interest in genealogy and their current interests and research areas. All participants (n=8) were drawn to genealogy to learn more about their family history. Although only two participants (n=2) had used IGG, all participants (n=8) incorporated genetic genealogy in their genealogy research. All participants (n=8) used traditional documentary research. Some participants specified historical time periods or geographical areas of interest. In the researcher's opinion, having experience in both genetic genealogy and traditional documentary research gave participants a more informed perspective when answering the questions posed in the present study. The four themes and two subthemes that emerged from the interviews are presented and discussed in detail in the section that follows Table 3.

Table 3*Genealogical Interests of Genealogists (n=8)*

Initial Interest	Current Interests/Research
Family mystery Family history/research	Genetic genealogy Documentary research Focus on the Southern United States, Colonial America, and African American ancestry
Combining fields of study Family history/research	Genetic genealogy Documentary research Focus on European and Texas ancestry
Family history/research	Genetic genealogy Documentary research
Family history/research	Genetic genealogy Documentary research Genealogical preservation Teaching research techniques
Family mystery	Genetic genealogy Documentary research Focus on the United States from the 18 th to 20 th century
Family history/research	Genetic genealogy Documentary research Focus on the Southern United States
Family history/research	Genetic genealogy Documentary research
Family history/research	Genetic genealogy Documentary research

Theme 1: Benefits and Risks in Using IGG

The following section discusses the participants' views on the benefits and risks of using IGG. Two subthemes of risks emerged: misuse and misidentification. As one participant aptly put it, "my concern is unintended consequences of allowing unfettered access." Eight participants (n=8) provided examples of benefits, and seven participants (n=7) provided examples of risks. One participant was "not sure" about the risks involved in using IGG. As one would expect, the underlying concept of identification permeated their views of both the benefits and risks.

Benefits

The participants' answers to the study's questions revealed a series of benefits they believed would result from IGG, including solving cold cases, stopping specific perpetrators from committing further crimes, minimizing and correcting miscarriages of justice, identifying human remains, and providing closure. For example, one participant stated, "the benefits are tremendous ... being able to identify potential suspects where no other leads have previously existed. The benefits, to me, are rather astounding."

Three participants (n=3) specifically stated its benefit in solving crimes. One participant believed that IGG was "a new tool" to help law enforcement "solve cold cases or solves cases that have DNA and otherwise would not be solved." A second participant believed IGG could "lead to breakthroughs" in solving crimes. Another participant acknowledged genealogists are helping law enforcement solve crimes by identifying the perpetrators and thought IGG was a "benefit to society since we have so many unsolved crimes." One participant believed the main benefit was the ability it gave law enforcement to "get a dangerous person off the streets." Adding specificity by stating it could "stop a murderer or rapist" from committing further crimes, a second participant echoed the same sentiment.

Four participants (n=4) addressed the benefits of using IGG in correcting miscarriages of justice, such as using it in exonerations, with one stating they had heard IGG could be used to "release somebody that's been unfairly [convicted]." The participant touched on the trust and confidence placed in the criminal justice system that "when they put somebody in jail that they've got the right person." In the participant's opinion, "there's been a lot of discrimination in stuff like that in the past," and believed that because "DNA can do that [prove it is the right person]," IGG would be beneficial to use in exonerations. One participant specified the types of exonerations where it should be applied by stating IGG could be used for individuals who have

been “charged with murder or rape and serving a sentence but [are] innocent of those crimes.” The third participant echoed how IGG and its use of DNA could overturn cases where “they (the exonerees) weren’t there, at that crime scene for it to be committed.” IGG could decrease the need for exonerations because it would help “mak[e] sure that law enforcement arrest or that the right person is prosecuted for the crime.” The fourth participant believed IGG could be used to “verify that defendants are guilty or that the innocent are [innocent], then the police can proceed to find others who could have committed the crime.”

Four participants (n=4) discussed the benefit of using IGG in crimes with unidentified human remains. According to one participant, “in this day and age when people are disappearing that becomes, I think that [IGG] should be done” because it has the “capability [of] IDing an individual that ... you’re not able to find out who this individual is, so DNA ... might match at some point in finding a ... John or Jane Doe.” The participant explained it as “hav[ing] a corpse ... no identification, no nothing, and you then tak[e] DNA to identify ... the remains that are found.” A similar view was expressed by another participant who stated IGG could help identify “deceased people who are unidentified like John and Jane Does.” One participant added that it could also help identify “living John and Jane Does ... infants that are abandoned at birth.” Two participants (n=2) addressed using IGG in criminal incidents of mass violence. It would help identify “victims of, like, 9/11, victims, let’s say, of [a] mass criminal act that has a lot of victims” and added that it could also help in “identifying perpetrators” who may have perished in the commission of the criminal act. A second participant shared that “they’ve identified a majority of them ... the people at 9/11 ... that died. I think there are still some they haven’t identified [be]cause they don’t have the DNA.”

Although not related to IGG in that the following scenarios or examples are not crime specific, two participants (n=2) shared examples of other benefits of using genetic genealogy,

which does not include the law enforcement aspect. For example, one participant mentioned its application in “adoptee research [and] discovering birth families.” Another participant noted:

She and several others [genealogists] have been involved with identifying MIAs [missing in action] from Vietnam, from World War II, Korea, and there’s several people I’m friends with, been associated with. It’s just neat, you know, they are able to find the remains in a crashed airplane from WWII or Vietnam or Korea. They have the database here of the relatives, now they find DNA, and so they got this database, so they compare the database.

Four participants (n=4) either directly or indirectly addressed the issue of closure. The idea of IGG providing closure in criminal investigations resonated with one participant’s remarks about how the use of genetic genealogy has helped identify soldiers who are MIA: “you know, that’s always [a] happy [feeling] when you can find, identify some remains from 50 years or more ago.” IGG benefits victims and their families waiting for years to know who the perpetrator(s) of the crime is or if their missing family member has been found and identified. As a participant affirmed, IGG can “help victims have closure on their case.” Another participant agreed, stating it “provides closure for victim’s families once cases are solved and closed.”

Risks

The participants’ answers to the study’s questions also revealed a series of risks they believed would result from the use of IGG. One participant felt that “the risks to the individual are slim.” Another participant noted:

The greatest risk to me is that a person's DNA is the most unique identifier. There is nothing else, not fingerprints, not retina scans, nothing that identifies us as completely as our DNA identifies us. Now, of course, we are all interrelated, so we all share scraps and bits and pieces with ... many other people in our families, and certainly we ... share

common ancestors.

Two participants (n=2) cited the risk of exposing family members to becoming part of an investigation who did not opt in or provide consent for their DNA data to be accessed. One participant was concerned with exposure resulting from them “managing others’ accounts like family members one asked to test and those [family members] one connects to [and] who did not sign up for or agree with law enforcement use.” The same participant was concerned that law enforcement would have “access to all information in the databases,” including [for] themselves and the family members for whose account the participant manages. As another participant explained:

I share DNA with my cousins, so I’m, even though I had them shut off ... we have the same relatives. We match a lot of the same people on the DNA side, so maybe that I’m exposing other people, other of my relatives

One participant identified a risk in “unintentional disclosure that leads to problems within a case.” An example the participant gave was “family members finding out through leaks from law enforcement, or someone involved in the case, and that getting back to a perpetrator.”

Concerned with the effects IGG could have on the genealogy community and genealogy research, a participant opined that there is “a risk that people will not provide the DNA results anymore. They will go private [because it] would be viewed in a negative way.” This would “hurt the genealogy community or the researchers because people will either not agree to have their DNA used, or they will stop using DNA as a way to find [one’s] ancestry out of fear that it could be used for law enforcement purposes.”

Three participants (n=3) mentioned the risk of “family secrets” being uncovered while using IGG and those secrets becoming known to family members as an unexpected result of the investigation. For example, one participant with experience in genetic genealogy and IGG noted

that they “always come across people who are either adopted or maybe they've just discovered that their father [or their mother] is not their father or mother ... and we also see that same thing in law enforcement.” Although not specific to how law enforcement would react to finding family secrets, another participant described the complications family members have in deciding how to respond when a family secret is discovered as follows:

When a person finds out there's a big secret in their history, you know, like different parent, different grandparent, whatever, they tend to go one of two ways. Some people are very gracious about it and, ‘Well, I love my grandma, and I'm not gonna embarrass her as long as she's alive, and so I just don't say a lot about this.’ And then there are the people that are like, ‘I'm shouting it from the rooftops. We're getting these skeletons out of the closet’.

Subtheme 1: Misuse

Two participants (n=2) did not have concerns about misuse. One participant focused on the aspect of the forensic DNA techniques used in IGG and stated, “I trust the techniques and accuracy of the scientists involved.” Three participants (n=3) acknowledged that misuse could be a “big problem.” One participant simply expressed concern about “someone misapplying the information or the data.” Without the proper oversight or regulation, the participant noted their fears of “something happening” with “handing over all of this data to law enforcement” and whether law enforcement “should have that data and the risk of that data being exposed to other agencies or institutions or entities or businesses.” When asked to elaborate on what constituted data, the participant identified raw DNA data and information found in family trees, the lists of matches, the data entered to create one's account in DNA databases and associated with one's DNA kits, such as credit card information, and data belonging to matches who did not opt in or consent to law enforcement use. The data is:

Information about me personally, about relatives that gave me permission to put them into the account that I manage, but then also the people who connect to me in some way because there are people who connect to me, but they have private accounts. It's not for the public.

Two participants (n=2) feared misuse due to injustices by law enforcement against Blacks. As one participant shared:

I also have other fears, as an African American, and how that data could be used because of the injustices that we face as African Americans and having such a high population of African Americans incarcerated, and so that is a concern that the tool could be abused by law enforcement.

The second participant also noted a similar hesitancy, “as, uh, African-American person, I really believe that at some point there is some law enforcement that even though you have DNA and they can prove that a person was innocent, they do not follow through.”

Another participant noted that:

In terms of specific personal identification, DNA is the ultimate identifier, and for the same reasons that I don't think people should hand over a packet to anyone that contains their birth certificate, passport, driver's license, etc., I think we need to exercise extreme caution.

The participant acknowledged that the use of IGG can be very effective but believed it could also “easily be misused or abused in the future,” emphasizing the need to “place common-sense restrictions on its use now before it's too late.” The participant expressed “serious concerns” that allowing anybody to use one's raw data or any technique “would allow them to reconstruct our raw DNA from searching through other matches” and “find[ing] out that you group together with 20 other family members who all have the same heritable condition, then

they will lump you into that group.” Specifically, the participant was concerned that there would be abuses by governments and insurance companies from “using genetic information against individuals.”

Subtheme 2: Misidentification

Focusing on the aspect of the forensic DNA techniques, one participant did not have concerns with misidentification for the same reasons they did not have problems with misuse; they “trust the techniques and accuracy of the scientists involved.” However, six participants (n=6) identified misidentification as a concern, especially “without the full support of genealogists.” In general, misidentification could result from not using proper techniques or “good genealogy” and not being sufficiently skilled in genealogy. As one participant put it, “that’s what scares me, I mean, somebody that doesn’t know what they’re doing.” The participant added that “law enforcement needs to have more courses ... and hire people with good instructional education on how to do it ... [be]cause it takes genealogists, too. It is not all science. It’s, part of it is genealogy.” Another participant’s concerns arose from their opinion that the “the average genealogist cannot match the DNA to the documents to build a tree and do what she [CeCe Moore] does.” Adding that CeCe Moore is “one person of maybe a handful of people who can really do that kind of complex work.”

Two participants (n=2) noted the importance of having skilled genealogists certified in the use of DNA in genealogical research to correctly interpret the results of DNA tests because DNA is accurate and will provide “the right identification.” However, misidentifications can occur when DNA data and the resultant matches are misinterpreted. In other words, the relatedness or degrees of kinship between individuals and their matches or genetic relatives are misread. One participant explained, “it gets complicated even with DNA ... it could be a first cousin, could be, you know, an uncle. ... you gotta have a certain set of skills to know and

understand DNA matches and centimorgans.” Because of this complexity, the participant emphasized the need for whoever is working on the genealogy part of IGG to be “highly skilled...to build a tree in such a way that can narrow down through multiple families, paternal, maternal lines to narrow it down to one or two people who could possibly be the suspect or kin to the suspect.” This participant worried about “who [would] determine [the leads or suspect]? Is it going to be the genealogist, and then, how skilled are they ... or will it be law enforcement counting on the genealogist?”

Two participants (n=2) who have both used IGG noted that misidentification can occur because of the family secrets that are often found in genealogical research and for which one cannot control. One of them identified these family secrets as their “biggest hurdle [or] roadblock” because the DNA ends up showing that “the suspect or somebody close to the suspect has an unknown parent or parents...they're not in the genetic line” even if paperwork and documents say otherwise. The second participant explained it as follows:

One of the things you can't control, though, is a part of a tree might show that their family tree is something, but their father or their grandfather may have had an affair, and therefore it looks like, in a family tree, someone is married to so and so, but he's not really the father, the genetic father. And so, when you go to test a son or a grandson of that father, [it] is not really the father, the genetic biological father. That's where misidentification can come in. ...Then we're looking for someone that the grandfather had a relationship with another lady, and in another whole other tree.

Another aspect that cannot be controlled and can result in misidentification is when family trees are built from erroneous information resulting in inaccurate family trees. One participant explained that this happens when people automatically add people to one's family tree without “truly doing the research” and finding documentation or DNA matches supporting

those links. Sometimes, people take this information from other family trees. Sometimes, the DTC genetic companies use computer algorithms that provide hints based on one's name searches or names already in one's family trees. One participant noted:

They're [hints] not even bulletproof at this point because I've gotten matches and suggestions from the computer. But because I do documentation matches, I'm like, "This is way wrong." And that is a big conversation in the genealogy community about these services that the computer is giving you hints of people you could be possibly kin to, and it's just way wrong.

Another aspect that cannot be controlled is history, leading to misidentifications. As one participant stated, "You have to do research about the place, about what was happening in history, all these different things to piece together this amazing puzzle." Specific to African American ancestry, the same participant explained:

If you're not doing African American research, that's a concern about misidentifying and having a select group of people do this work, and they are not familiar with the things and the horrors that went on. How can you draw a conclusion about who is kin to whom? Most African Americans have some percentage of White and others throughout our history from slavery. They have a percentage somewhere along the way of somebody who intermingled, whether willingly or unwillingly, with an African person. You can pick up all kinds of matches, so you have to be highly skilled to be able to go through that much data and try to figure it out. For African Americans, we have this huge brick wall that once we get to a certain point, records are hard to find. We're learning now that the records do exist a little bit. They didn't burn down in the courthouse or whatever, but the only way we can find our ancestry is by going through that White ancestry. You have DNA that's telling you that you are somehow connected to a White family. And once you

can identify that family, then you can sometimes find your ancestors, but it's only so far back you can go. It's very rare that you can go back to Africa because we didn't have names or just a first name. You have to research the records of slaveowners. If you're lucky enough to have a relative that served in the Civil War, that may open the door because their application to serve included a lot of information. I would love to see a family tree built to solve a crime for African American ancestry because it is extremely complex.

Two participants (n=2) who have used IGG further explained their experience in using IGG when asked to address issues with misuse and misidentification. The first participant noted methodology exists to control potential misguidance and underscored the importance of having "solid" genetic data to initiate the IGG process. For example, "we're using genetic data plus numerous family trees, family connections to narrow down, so we don't misidentify someone," and it includes analyzing "different angles of the genetic [data] and who they match, the family matches, so do we have five or six genetic matches that point to this one family." The second participant emphasized that the role of the genealogist in IGG is to "identify a potential lead" by "identify[ing] the DNA as close, as close as we can to a certain line of people, and then we hand that over, that information over to them [law enforcement]." The participant further explained they "don't say this is your suspect" and make sure the "reports are written up in such a way that [it is clear] this is a lead." The participant "considered it at the same level of somebody [that] called in and said, 'I think so-and-so is connected to this crime, and here's why I think [so]'."

Although participants identified multiple ways in which misuse and misidentification could occur, they also provided mechanisms to minimize both. One of the most important was either directly (n=4) or indirectly (n=2) identified: characteristics of the genealogists involved in IGG. These characteristics included their level of knowledge and skill, diligence, and being

ethical. One participant suggested, “Make sure that you have a forensic genealogist that really works with DNA, which is several in, in the community [of genealogists].” Another participant noted that “the people that are doing the matching [should be] diligent and know what they’re doing.” Diligence will help minimize errors from family secrets and inaccurate family trees and ensure the actual suspect is correctly identified. In cases where the potential suspect is deceased, the IGG process must use a “close family member, a sister or maybe a first cousin or ... a child of that person to help verify that that’s the suspect” if exhuming the body is not possible. The same participant noted the importance of “reference testing” and “surreptitious testing” of the potential suspect(s) to confirm “the identity of the actual suspect.” Adding to the importance of ensuring who the actual suspect is, one participant mentioned the need for “good genealogy” and pointed out that “they’re not relying on just genealogy [and] family trees to convict someone” because “ultimately ... when they do a DNA test on a person they’ve identified, that has to match the DNA that was found in whatever the crime [scene] was.”

Another mechanism identified by three participants (n=3) is the existence of codes of ethics and standards for genealogists, whether professional or amateur. For example, one participant advised, “now you need, ethically for genealogists that are going to ask somebody to do [DNA] testing, you have to explain all of the repercussions and put it in writing if you can and explain it very clearly to them.” The participant identified a book, “the Genealogical Proof Standard” that specifies “genealogical standards that ethical genealogists go by, and it also explains how we conduct research and everything, [and] they’ve added in a section on DNA.” Another participant wondered “who [was] going to control the standards of proof [genealogists or law enforcement]” and explained that “you have to go do so many things to make sure that this is accurate before you say it’s accurate.” Similarly, and already mentioned, a participant touched on the need to have certified genetic genealogists.

Lastly, three participants (n=3) referred to policies, procedures, and legislation regarding IGG use. One participant believed “the current policies and procedures are reasonable ... they allow for good results when it is necessary for law enforcement to access these databases.” Another participant noted, “that there are laws in place for law enforcement to follow due process to properly obtain any needed DNA data.” A third participant agreed that “checks and balances should be set up” and shared that “Maryland ha[d] just passed, a few months, I guess, ha[d] passed, I’m not sure if it’s laws, on how genealogy information and DNA testing can be used” but was “not familiar with other places, other states.” The same participant was also aware “the Justice Department [had come] out with something, too, some guidelines” and wondered if it resembled an “interstate compact ... that the states can all agree so that it’s the same throughout.”

Although all participants (n=8) were genealogists and the focus of the study was on the role of genealogists in IGG, readers should conclude that the level of knowledge and skill, being diligent in the research and investigation, following standards and ethics, and following policy and guidelines specific to IGG are of utmost importance for genealogists. It is critical to minimize misuse and misidentification to build trust and confidence in using this technique. As one participant who has used IGG noted with regards to the viewpoint of an individual who is misidentified:

People ... get upset if they think they’ve been misidentified ... law enforcement thinks it’s someone and then it ended up being not them at all, not even close to being them ... and so they don’t understand ... like, why did they come to my house, why did they take DNA [from] me ... they’re a good person [so] why was someone looking at them ... investigating them ... what right did they have, what right did they have to think I would do something like that.

Theme 2: Genealogists' Support for the Use of IGG

All participants (n=8) supported the use of IGG. One participant believed using IGG was “the right thing to do” as it was currently allowed and used. A second participant thought “law enforcement should use any means at their disposal to solve crimes.” Another participant added that although they support its use, they’re “not going out and trying to convince other people to open theirs up [allow access to law enforcement].” This participant added that they have opted to allow law enforcement access to their account because it could “help find someone that might harm other people and that [has] already harmed someone.” However, the participant has not allowed it for their relatives’ accounts that they manage, believing they did not have “the right to do [that].” Echoing what has already been mentioned as a benefit, one participant supported its use “because it helps solve crimes [and] also helps families get some resolution.”

Three participants (n=3) qualified their support by identifying examples when they would not be in support of its use. Two participants’ support depended on the kind of crime. One participant supported its use for murders and sexual crimes but not for “lesser crimes and other things.” Additionally, this participant managed DNA kits for several family members and was unsure they would support its use for all crimes. The second participant supported its use only in identifying “suspects of violent crimes and homicides.” Two participants’ support depended on how law enforcement gained access to the data held in the genetic genealogy databases. Both participants supported law enforcement accessing databases that provide test takers with an opt-in option or give consent for their data to be accessed by law enforcement. Law enforcement would only be allowed to access those databases. In the case of private DTC genetic genealogy databases, such as Ancestry, which do not currently permit law enforcement access or an opt-in option, both participants agreed with the current policy set by these companies requiring law enforcement to obtain legal process. As one participant noted, these companies, by default,

automatically opt everybody out. One participant added that if the private companies changed their policy, they would still only support IGG use if the companies provided the option to opt in or opt out and law enforcement only accessed the opt-in database. This participant noted they still had mixed feelings about using a warrant or subpoena, explaining that they “just couldn't blanket say I don't have a problem with it [because of] the whole ‘camel's nose in the tent’ thing.” The participant further explained their position:

Law enforcement looking at anybody's matches or anybody's data who has not specifically granted them specific permission to do so by opting-in a database, then that should be severely restricted. Generally speaking, just having a subpoena or a search warrant might not reach the level of restriction that I would see as being valid because of possible misuse. I totally, though, absolutely, totally do support it in cases of violent crimes, and the second instance would be [human] remains, identifying remains, the Jane Doe type cases, and everything. I would support it there even if people had not opted in, but I do not, cannot say that I would completely support it just because a subpoena was presented. And I appreciate that the companies have reviewed those in many cases on an individual basis instead of just automatically responding.

In personalizing how IGG affects them, one participant noted:

When I look at my DNA, that is not foremost in my mind the fact that they're going to be, well, that they might use my DNA to solve a crime. That's fine with me, but it's just very much in the background. I don't focus on it a whole lot.

All participants (n=8) identified specific crimes and other instances in which it should be used: rape (n=7), sexual crimes (n=1), assault (n=1), murder (n=6), attempted murder (n=1), criminal incidents of mass violence (n=2), violent crimes against persons (n=2), unidentified human remains (n=5), robberies where DNA is left at the crime scene (n=1), exonerations (n=4),

and cold cases (n=1). Regarding cold cases, the participant added, “especially those very old and unsolved if DNA is still available.” Two participants (n=2) who identified specific crimes also commented on “what the law allows” and “the way they [genetic genealogy databases] have it now.” One participant fully supportive of exonerating wrongly convicted people opined that IGG is not “the most effective way to do that.” Two participants (n=2) did not support its use in thefts, burglaries, or similar crimes where DNA is left behind at the crime scene, with one participant stating, “That is a hot subject ... where there’s not a violent crime. I think that it’s probably not ethical to use this type of research to identify the people [who] broke into homes.” Two participants (n=2) added that it could be used in instances where “babies ... are left by the side of the road and die from their mother leaving them.” The second participant added that:

They [babies] are not killed, but they're left, and they die of, you know, either the elements or, you know. There's not a lot of us that will work those types of cases either because there are people who think that the mothers had their right to do that. Because then you get into that slippery slope of the abortion issue, you know. ...We, you know, can we not agree that a baby doesn't deserve to die, right? If you carry the baby that long?

Three participants (n=3) pointed to the current political landscape and lack of belief in science as obstacles to gaining overall support for IGG. One participant stated, “Nobody would support it right now with the way the country is split.” Another participant noted that “there’s always going to be push back; I mean, we’re, we’re a divided country right now.” Finally, the third participant explained that “the public, even now, has a tendency not to believe science, even in this epidemic that we’re going through.”

Another participant opined that IGG “may just die away” if it is too “cost-prohibitive in the long term” or would only be used in “unique, specialized circumstances like where the body

count is so high that we must find who did this.” The same participant questioned whether it could be effectively “used for the masses” based on the limited racial or ethnic make-up of most participants in genetic genealogy databases.

Theme 3: Consent, Privacy, and Confidentiality

Participants acknowledged that when the first cases of IGG occurred, concerns arose regarding consent, privacy, and confidentiality. One participant cited the “publicity of the Golden State Killer” as the catalyst for the changes affecting genealogists, law enforcement, public genetic genealogy databases, and private DTC genetic companies and genealogy databases. A second participant believed that customers became upset after finding out law enforcement had used GEDmatch in the Golden State Killer case and may have withdrawn their data from its database. A third participant agreed that customers became upset because “people did not know in some cases that ... law enforcement would have access to their information.” One participant noted an unforeseen issue arose for them as managers of family members’ accounts who took DNA tests before the changes and have passed away. Noting the changes that came about since the Golden State Killer case, one participant stated, “So now I think ... loopholes have been closed, and so today I think we have some reasonable protections in place to protect the consumer and to allow law enforcement access that is helpful.”

Five participants (n=5) discussed existing guidelines for genealogists (n=3) and built-in mechanisms in databases (n=4) that address consent, privacy, and confidentiality regardless of whether IGG is used or not. As noted in the results for Theme 1, three participants (n=3) explained that genealogists who are ethical and pursue certification and accreditation must follow codes of ethics and standards for genealogists, whether professional or amateur. In following the standards and codes of ethics, one participant who asks others to take DNA tests and manages their accounts in several databases explains to them “what’s going on” and “why

I'm doing it, for DNA, for genealogical purposes.” One of the four participants (n=4) who addressed built-in mechanisms believed that:

When they [test takers] decided to send in their spit/swab and test, everyone knew that their DNA was out of their hands and ‘could’ be used for anything else. I have thoroughly read through the terms of use where I have my DNA tested and the other companies where I have uploaded my raw [DNA] data. And I feel like the user agreements and company policies are clearly stated.

Another participant advised that to protect the privacy of those living, “Ancestry only shows names of deceased people in their database and says ‘private’ for those who are alive.” Another participant, who asks family members to test and pays for the DNA tests, provides the consent forms accompanying the DNA kits to those who agree to test. In discussing confidentiality, two participants (n=2) noted the account profiles in the databases do not have to display an individual’s complete name, “some people put their full name on the databases, some people use their initials.” One participant noted that people who take DNA tests as consumers “can choose how confidential they want to make it ... There’s choice there.” In discussing consent and control of one’s genetic data, one participant believed:

All testers should examine the statements by their testing companies, make their decisions about what to do with their DNA, and either opt in with consent or opt out and remove their DNA test from the site and ask the company to remove it from their database.

Another participant advised that “all the companies have a consent form that you're consenting to your DNA being in a public [or private] database.” The same participant noted that although genetic data in 23andMe’s database is not being used by law enforcement, “23andMe ... is now using it [genetic data] for other purposes [health] than just genealogy.” Another

participant was concerned with a “complete loss of personal privacy ... in the most invasive sense because anybody who had your complete genome obviously can see into every aspect of your being, every health condition and so on” due to DNA being “this unique personal identifier.”

Six participants (n=6) discussed the changes that have taken place related to IGG, with four participants (n=4) specifying differences across public and private genetic genealogy databases. One participant who has used IGG advised that “now we only can use two databases ... GEDmatch and Family Tree [Family Tree DNA] ... if you upload there, you can opt in for law enforcement [access], or you can opt out.” One participant noted that now “you have the choice of how you want to control your data” in the companies that allow access to law enforcement, such as GEDmatch and Family Tree DNA. A second participant added that “they [companies] are upfront about ... allow[ing] law enforcement in there.” Another participant was “pretty happy with the way things are currently set up, for the most part, because ... there’s an option to opt out or opt in,” and “most of the companies do a decent job of that today [companies informing consumers of their policies] ... [which] they didn’t two or three years ago.” A participant with experience using IGG explained that “if they've opted into law enforcement sharing, then they know that they're being compared against, or they're showing up in a list of matches for law enforcement cases ... Their DNA is not being used without their permission now.” The participant added that “they [test takers] have the right to either be opted in for law enforcement [access] or not.” Noting there are two different beliefs in the opt-in/opt-out choice, a participant with experience using IGG explained that”

[Family Tree DNA] automatically puts you into the pool where law enforcement can see ... you have to actually check the box that you don’t want it to be seen by others, by law enforcement. ...GEDmatch, on the other hand, automatically pulls you out. You have to consent and go ahead and let your DNA be put as being seen by law enforcement.

In contrast to the two companies that provide the opt-in/opt-out option, private companies like Ancestry, 23andMe, and MyHeritage do not allow law enforcement to use their databases for IGG. A participant with experience using IGG noted that Ancestry as a “private database ... [does] not allow any law enforcement to access or to look at. ...There’s no way to upload anything in Ancestry. There’s no way to do any of that, so ... that’s very controlling.” Another participant with experience using IGG agreed that law enforcement can still attempt to use these private companies. Still, the companies require legal process and will not automatically respond to such requests. A third participant emphasized that “Ancestry won’t, and 23andMe will not cooperate at all with law enforcement.” Finally, one participant addressed the difference among policies, “If we consent to give something over to make it public, then it would be public. If we didn’t, it would be private and protected within the service we are using. ...That’s how it should be with the services like Ancestry.”

Although changes have been made through the policies enacted by the different genealogy companies providing DNA testing and hosting genetic genealogy databases, three participants (n=3) shared lingering concerns about taking a DNA test and the IGG process. One participant's concern regarding control of one’s data stemmed from the variance in policies across companies explaining that:

With one of the major companies, you can delete your results, and supposedly they do not store samples for a long period of time. But with another major company, they do store the samples forever, as far as we know. ...That’s a huge difference right there because even if you were to delete your results or if you made your results publicly inaccessible, completely privatize them, they still got your actual physical DNA stored somewhere.

One participant believed the use of IGG continued to infringe on the privacy rights of

people who took DNA tests for “their own personal purpose and not to have law enforcement use their DNA data in that way. That wasn’t the intent for that individual.” The same participant believed IGG “breaks confidentiality whether they name a person or not” because those identified as related to the suspect will come under suspicion, be surveilled, or have to “disclose personal information.” The participant added that without “proper oversight and regulations,” they were not confident that all law enforcement agencies would “take great care in protecting the confidentiality of people they may be investigating” because they are “sloppy or don’t have enough support and resources [and] you just never know with law enforcement. That’s my concern.” A second participant echoed similar concerns stating that “there should be confidentiality for those individuals. ...[so] they won’t be exposed at some point ... with the individual that they’re looking for.” Law enforcement should do their best to keep “their identity private but [get] enough of the information to get to the individual that they’re looking for;” for example, not “print[ing] names of who [they] got the relationships from unless it’s absolutely necessary.” Another participant agreed that for both the test takers and family members identified who did not take a test, “law enforcement and testing companies should keep the identity of the testers whose DNA they use to solve the crimes private from everyone except investigators and prosecutors in the case, as they would a witness.” Another participant who also discussed privacy concerns explained they supported the use of IGG if:

Researchers are accessing databases for people who have opted in but only so far as they link individuals together and identify groups to home in on suspects [but] not to the point that they would obtain each tester’s personal information or contact information that they [testers] have submitted to the company. ... I don't think that they should ever have access to that.

As with results discussed in previous themes, concerns with consent, privacy, and

confidentiality were also related to the skill, knowledge, and thoroughness of genealogists and law enforcement officers. One participant noted that problems depend on the individual who is doing the research: “if they’re good, they’re going to do okay ... as long as they’re doing it correctly ... if somebody is in there and sloppy ... identifications are not as well as they could be.” The participant added that once somebody was identified as a suspect, law enforcement needed to “try to get a cigarette butt or a coffee cup or something” to “make sure that that specifically is the person who left DNA at the crime scene.”

Seven participants (n=7) noted that issues with control, privacy, and confidentiality would arise if genealogy companies hosting databases that allow law enforcement access stopped providing customers with an opt-in/opt-out option or violated their policies regarding law enforcement access. As one participant stated, “I don’t think it infringes on ... their privacy rights, as long ... as they check the box in the databases that it’s okay to use their information. ... they’ve given ... consent ... for that purpose.” Another participant would not be okay “if any testing companies are currently offering access to testers who have not specifically opted in.” A third participant emphasized that people “should be able to have control of the data that is in there as it relates to them. It should not be utilized or sold or made public without their consent.”

Two participants (n=2) addressed consent, privacy, and confidentiality as they applied to their roles as managers of multiple accounts for family members they had asked to take DNA tests. One participant was unsure whether the accounts of those who have died, forgotten they have accounts, or have not accessed their accounts to know about the new opt-in or opt-out options were automatically opted in or included in law enforcement-accessible databases. The participant was unsure whether they, as the account manager, had the right to consent or opt those accounts in for law enforcement access. The participant believed a violation of privacy rights existed if the accounts of individuals with submitted DNA kits who died before the option

to opt in or opt out was provided were not automatically opted out of any law enforcement access. Although the participant has considered withdrawing those accounts from the database(s), the participant's research into their ancestry is ongoing, necessitating they leave the kits in the database(s), especially in GEDmatch, due to the platform's ability for members to "share across platforms." The participant noted they have chosen to leave the kits in the database(s) for now, monitor how IGG is being used, and "see what's gonna happen with it."

Another participant who also manages accounts for others stated:

When I have them [family members] tested and all, I usually do not have them in that database. ...When I go to the company, and I'm loading their DNA, it says, 'Do you want to share DNA?' I say, 'No.' If it's me, I say, 'Yes.'

Participants had varied responses regarding the privacy and confidentiality of family members who had not taken a DNA test. One participant shared their thoughts as follows: "I hate to say if I had relatives that they [law enforcement] used my DNA ... to figure out who my cousin might be who committed that crime ... you do the crime [you do the time]" and added "that's the way it is now. They say it doesn't matter who you are; your DNA is in the database." Whether a family member tested and opted out or did not test, "they are also getting it [DNA] from my siblings and cousins ... because I did it [took the DNA test]." A second participant shared a similar view regarding the privacy of non-test takers, "that's not just law enforcement ... that's just DNA tests, in general. ... you share DNA with other people" and "that would be a privacy concern." The participant added that "the point of the DNA test is that you're trying to find other people [related to you] who may know more about your family tree than you do." Even when a list of matches is generated, "all you see is the individual match. You have to click on their tree to see who their family members are ... and some of them don't even have trees." Another participant was unsure that the privacy of family members could be guaranteed because

“someone is going to say that they are related.” Relatedness could be identified through analyzing DNA profiles, genealogical research, and the course of an investigation.

Another participant with experience using IGG noted that issues with privacy and confidentiality of family members who did not test are “where some of the fine line comes in,” but believed that it is “between that person and their family member” who may “be upset with them ... but ... the family members have to be respectful of the other person.” The participant added that these DTC DNA kits are available nationally and internationally for anyone to take a test adding that “if they’re implicating their family member ... the problem is between them and their family member.” One participant agreed that the issues with family members who did not take a test were “tricky” and had not previously thought about a potential infringement on the privacy of family members who did not take a DNA test but believed that it did not. The participant reiterated that, as with those who have tested, “investigators should be careful and not be divulging individuals who ... were used in order to get to identify the actual perpetrator.” The participant noted that regardless of whether they did or did not consent to take DNA tests, family members are still going to be a part of the investigation because of the “[familial] links,” but added that “the information that I was receiving [the DNA matches] benefits me and our links to our ancestors.”

Regarding the privacy rights of family members who did not test, one of the participants who has used IGG neither believed there was an infringement on their privacy rights nor their confidentiality was broken because “their DNA is not in the database.” Another participant felt that there “most definitely” was a privacy infringement on family members who did not take a DNA test based on what the participant saw in the television show *The Genetic Detective*. In the television show, genealogists used the information from those who had DNA kits in the database to identify family members who “had nothing to do with this DNA database, and now you are

tracking them and possibly collecting evidence.” According to the participant, “it is a total violation of the person’s privacy and their rights because how else would you have identified them.” This participant also believed the use of IGG broke the confidentiality of family members who had not taken a DNA test. One participant observed that “that’s just a kind of crappy thing, isn’t it?” because it “can indirectly infringe upon their privacy” but noted that DNA could only uniquely identify one individual. This participant did not see confidentiality as an issue because “if they didn’t test, then they don’t have an email or other contact info posted ... they have not offered up any traditional identifiers.” The participant echoed another participant’s view of family members respecting an individual’s choice in stating that:

It is up to that person whether they want to share that information in that manner or not. And I don't necessarily think that a person's right to share that should be restricted by others who might share a part of that person’s identifying information. And I’m a huge privacy advocate in every way, shape, and form, but I don't see that there is a practical way to separate that out, and so I see it more as a privacy invasion for each individual whose DNA is used inappropriately, but for the others in their family who could be identified through them submitting their DNA, that is unfortunate for them if they have concerns about it, [an] unintended consequence. But I don't see that it is much of, is a privacy invasion as the other.

Even when stating the purpose of taking a DNA test would be for genealogical research, one participant shared they have heard several people say they do not want to take DNA tests, with some saying, “No, no, no. I’m not gonna do that. The FBI will know about me” to which the participant responds, “I don’t know what you did.” The participant noted that one distant family member in military intelligence refused to take a DNA test, saying, “No way. I’m not taking it.” The participant noted that that is the “type of individual who is usually the one that is

gonna say no and won't take a test." Another participant has told those who have been hesitant to take a test that they [the participant] "would be more concerned not taking the DNA, ... [and] would be more concerned about my trash because when they go through that, they can pick up all kinds of information about who you are as an individual."

Two participants (n=2) spoke explicitly about the current way that IGG works in discussing issues with consent, privacy, and confidentiality. One participant with experience using IGG shared that people's privacy is not "invaded" because "most of the time we're dealing with distant relatives, we're not dealing with, you know, a mother or father or sibling. I mean, we're lucky if we have a second cousin, and most people don't know their second cousins." In this participant's opinion, the privacy issue is not present anymore but acknowledged that individuals, including genealogists lacking experience in IGG use, believe the privacy issue still exists. In discussing one's DNA data, this participant shared that "we don't have access to their DNA besides how much DNA is shared ... with our suspect or Jane or John Doe and ... who they match," adding that "it's not like we can take their DNA and do anything with it. ... we just look at who they're related to." Regarding confidentiality, one participant answered:

I don't think it's that big of a deal if they're using my DNA because I think all they're going to use it for is as a guide ... to get into the lineage of the person who actually did the crime ... I'm just part of the puzzle ... even if it's a short distance, it's gonna be a distant match to me. ... They're not going to use it to prosecute somebody.

A couple of participants alluded to "unforeseen consequence[s]" and the inevitability of someone who has not tested having a part of their DNA already in a database. In response, participants discussed individual choice and the responsibilities of individuals, companies, and society, especially regarding consent, privacy, and confidentiality, as it involves genetic genealogy and IGG. One participant pointed out that "people willingly take the [DNA] test."

When they do, “they’re basically giving the right for others to see their genetic data ... [they’ve] already said, ‘It’s okay for this to happen’,” even if “genetic data ... is a private thing,” once an individual has given consent “it’s now in the public realm.” Concerning privacy for oneself and one’s family members, one participant simply stated that it is “something everybody has to think of when they’re doing a DNA test.”

Regarding Family Tree DNA automatically opting customers in, one participant stated, “It’s you as an individual that has to physically uncheck yourself.” Another participant noted that “people have to choose to upload their DNA ... so they really need to look at what they’re getting into, you know, before they make that choice,” noting that “people should, as much as it is possible, be informed beforehand of known uses ... expected or known future uses of their DNA.” The participant expressed they were “far more concern[ed] ... with [companies] obtaining actual informed consent,” especially when consumers “are sort of led to believe [by] ... major testing companies like MyHeritage ... Family Tree ... Ancestry ... 23andMe ... that this is a fun, harmless activity where they can find out if they need to wear a kilt or whatever.” Although the participant “would hope a lot of people would choose to opt in,” they emphasized that there “must absolutely be informed consent before anybody’s results are included in a law enforcement [accessible] database.” Furthermore, the participant insisted that each company:

Should be required to fully inform the consumer of what their company policy is ... be legally required to inform the consumer ... if their policy changes ... and allow the consumer the option of having their sample destroyed if they so choose.

One participant believed conversations about privacy and consent should be ongoing for those who are living and already in the database, those who are deceased and remain in the database, and those who will take and submit DNA kits in the future. This participant shared that for them “as a consumer,” they would “feel a little bit more secure and trusting of the process”

by having law enforcement go to the companies instead of having access to the databases, “whether the companies create some sort of law enforcement division that can do this work, whether it be through the algorithms or whether it be through having experienced, certified, or vetted paid genealogists to assist” to then provide law enforcement with the leads for them to run down, “kind of like Apple with their phones, you can come to us and ask us, and we’ll give you what you need, but you’re not going in.”

Theme 4: Public Awareness

One participant noted that the use of IGG to identify suspects and solve crimes was still “in its infancy,” requiring the “right regulations, oversight, and structure to be able to use this tool in an effective way.” The participant suggested law enforcement provide more information “on what their intention is, in terms of how it would be used.” The participant would like to know the federal government’s perspective on how it should be used. For example, the participant suggested more information should be provided regarding the level of skill or expertise of the genealogists working with law enforcement. In other words, who will “monitor” the skill level of the genealogists, and will law enforcement work with genealogists who are certified or accredited or those with years of experience and fully capable of effectively using genetic genealogy but not certified or accredited. The participant believed if the above was implemented and appropriately messaged to the public, the use of IGG would move towards becoming “a tool that will be in the toolbox of investigators across the nation.” Public awareness would increase, which could increase individuals opting in or giving consent to law enforcement to access their DNA data.

Seven participants (n=7) responded to the question of how support for the use of IGG could be gained from the public. All (n=7) believed messaging to the public would introduce and increase awareness of and education in the use of IGG and the process and provide information

to assist individuals in making their own decisions on whether they support it. The messaging could be through public campaigns, public service announcements, education through libraries, conference presentations, podcast episodes, and law enforcement and genealogists talking more about IGG. One participant did not believe the messaging should focus solely on gaining support from the public because the public “should remain skeptical” and “concerned about privacy rights” to create a “failsafe or a check against future abuses by the government or by any kind of private entities.”

One participant noted messaging “would help to ease the anxiety for the public in terms of DNA.” To get a positive result from the public, another participant believed the messaging should come from companies like Ancestry and 23andMe, explaining that with an individual’s consent, IGG can help solve crimes and that law enforcement does not have automatic access to the databases. The participant believed this was the best way to message the public because of the current level of distrust or mistrust in law enforcement and the federal government. The participant explained, “None of those agencies could come to me and convince me to believe that [they]’re going to be fair, [they]’re going to use the DNA properly.” The participant added, “It’s gonna have to come from the companies that we trust and that we’re trusting with our DNA and trusting that they’re going to protect us. That they will not just open the database up to anyone.” Additionally, the content of the message would need to be poignant and communicate “the good that they’re [companies] doing in helping solve crimes with people who have consented, who were willing to, you know, share their information to help a mother, you know, get justice for her child.” Although one participant agreed it would be nice if the companies put out messaging, they did not believe the companies would do so because they would “probably lose business.” However, the participant added “maybe in the future” and if it becomes more accepted.

Participants suggested that the public know more about its capabilities and learn how

IGG works or the process to understand it better. One participant wished law enforcement was “more open” with information about how they can use it to identify people noting that the public does not hear of IGG being used very often. Another participant added that “right now ...we just kind of hear about the end results.” Another participant who has used IGG suggested the public should be informed that it is a “good tool” to keep everyone safe and have safe communities because it identifies people who committed some “really bad crimes” and helps “find that person, so he or she doesn’t commit another offense.” Personalizing the message, the participant added, “if you’re asked to provide DNA, it’s because we’re trying to find a really bad criminal or someone who has committed a crime.” Another participant echoed the same message that it is a tool that can be used in “cases of very serious crimes or missing persons to great effect.” Finally, one participant who has used IGG suggested the public should know that “maybe it would deter some rapes from happening,” noting that they “keep waiting for that to happen [that] maybe crime will go down, you know, especially against women. I don’t know if it has or not.”

Three participants (n=3) suggested talking about the initiative to end the backlog of untested rape kits throughout the United States. One participant who has used IGG underscored the high incidence of “violence against women.” While acknowledging that there is “violence against men,” the participant noted that “most all [their] cases are crimes against women ... it seems that all of our cases are usually females ... we usually get the DNA from rape kits.” A second participant warned that IGG should not be used as a shortcut to resolve the backlog, adding that:

Resolv[ing] the backlog of cases [by] put[ting] everybody on it until they have tested every languishing rape kit, identified all of those people as best they can, using CODIS, and then ... cast[ing] a wider net if that fails to serve in the manner that it was intended to serve. And I think that would be a huge step toward improving public perception of law

enforcement's commitment to solve these, you know, cold cases and unsolved crimes.

In the experience of a participant who has used IGG, no one had “tried to go rogue like that [bypassing CODIS],” which would “not make any sense” because if the suspect’s DNA was already in CODIS, that “saves them money, saves us time.” Additionally, the participant noted that DOJ’s interim policy states IGG is only to be used in cases with no CODIS hit. Another participant who has used IGG noted:

All of these rapes that have happened and the kits that haven't either been processed or they have been processed, and there's not been a hit in CODIS. They're just sitting there, and sometimes they're, they're serial rapists, and they've just never gotten caught.

They’ve never been arrested to where their DNA would be taken and put into CODIS. ...I would hope that everybody would want to move forward with those, at least, you know, to clear some of this up. Maybe get some people off the streets, you know. ...You would think, you know, that this would be the subject that everybody would, would agree on, you know, this part of it. And I even think that about murder.

Two participants (n=2) noted that people need to educate themselves about the use of DNA in genetic genealogy and not just in IGG to: “make your own decision, research it, look at the positives and the negatives and so you can make an informed decision about what you want to do.” One participant noted that when it is explained on television, “it is so simplified...open your mouth, five minutes later they got the DNA test back.” One participant stated that “when you’re asking people to take [DNA] tests, you need to explain it, so the other people don’t feel hoodwinked if something comes up.” Another participant believed education would help explain the process so that the public can “fully understand and trust that it will only be used for specific purposes or specific kinds of crimes” and “know that privacy will not be violated.” In explaining the process of IGG, the public can be informed of the control mechanisms that are in place now,

how they can control access to their DNA data, how the data will be used, and who will be using it. A third participant believed it was important for the public to know that in using IGG, genealogists and law enforcement “just can’t go in there and arbitrarily retrieve it [DNA data]” without some type of legal process. The participant added, “It’s not available just for them to be skimming through and finding these individuals. It’s not set up for that.” Another participant wanted the public to know that individuals will not be convicted “just based on a genealogy family tree” because there “has to be other evidence to it besides just the DNA on the FamilyTreeDNA website.” The participant emphasized that IGG helps law enforcement identify potential suspects. Still, it does not convict a suspect, adding that “maybe some people don’t understand that they can’t convict somebody unless the DNA that they found on whatever the crime was, matches the individual that they have arrested.” One of the two participants who has used IGG wanted the public to know the following:

Law enforcement is not trying to be invasive ...Be trustful of law enforcement that they’re trying to do the best we can do, you know, in catching criminals, finding criminals, and to have closure, to help victims have closure on their case.

The second participant added:

We usually don’t take a case unless it’s been put into CODIS. ...We try to be as non-invasive as possible when we’re researching. If we do need to reach out to the family for whatever reason or if we think that somebody could either test for us or see if they tested, you know, maybe in Ancestry and then upload, you know, we always, that goes through the detectives. ...It’s not like some people think if that makes sense. It’s not complicated. I mean, the process is not complicated. It’s just long, and it’s arduous, and it’s granular, and it’s, you know, it’s just not easy because you just have to stick with it, and you have to have experience in all different areas, all different, you know, ethnicities, situations. You

have to know how to identify certain situations, and it just takes, you know, it's just doing. It's like an apprenticeship, you know, you can have a certain education, but then you have to go, and you have to apply it to actually learn.

Echoing the need to be able to identify specific situations and understand different ethnicities, one participant explained they had signed up to participate in the present study to “give an African American perspective” because:

We are very new to this space and very small when it comes down to the DNA sandbox. We're new to genealogy research. I mean, we've been researching a while, but it's a really small population of us. Whites have been doing this work for many, many years. They built the systems; they have had access to a lot of documents. We did not have access to a lot of documents because Whites controlled the documents and what they chose to scan and chose to make public. Now more African Americans are getting into this space. It is growing, but it's still small. DNA is still really new, and most of the people who could afford to do DNA cause it used to be quite expensive were Whites. Most folks in GEDmatch are Whites, and that's why we haven't used it as much because a lot of us don't understand it, and we're not at that level, and so they haven't uploaded a lot. Most of the people that I know, it was because I told them.

Lastly, one participant stressed that:

It is everyone's individual duty to be aware of the policies of the companies they test with, learn about the techniques and risks involved, make an informed decision, and help open up the way to assist law enforcement in solving crimes in any way that we can.

Discussion

This qualitative study aimed to examine genealogists' perceptions and knowledge of IGG, their opinions regarding areas of concern that have been raised, and whether they support

its use to solve crimes. Through interviews with eight genealogists, the researcher identified their level of support for the use of IGG by discussing its benefits, potential risks, and the kinds of crimes it should be used in; elicited opinions in the areas of misuse, misidentification, consent, privacy, and confidentiality; and gleaned their thoughts regarding public awareness of IGG.

From these interviews, the following four themes and two subthemes emerged:

- Theme 1: Benefits and risks in using IGG
 - Subtheme 1: Misuse
 - Subtheme 2: Misidentification
- Theme 2: Genealogists' support for the use of IGG
- Theme 3: Consent, privacy, and confidentiality
- Theme 4: Public awareness

The present study adds to the current literature on IGG through the various topics addressed by the participants. Participants who have used IGG discussed the technique in conjunction with privacy and confidentiality issues. All participants had opinions regarding the concerns arising from its use in the past and for its future. Participants were able to address various misconceptions of what IGG is and what it is not. Those who had a deeper understanding of the IGG process provided facts regarding the process, dispelling some of the misconceptions. In addition to the limited number of participants with experience using IGG (n=2), most participants (n=7) did not obtain a degree in criminal justice or criminology. One participant is seeking a graduate degree in criminal justice and is also one of the participants who has used IGG. Likewise, although six participants knew at least one law enforcement officer, this does not translate to knowing details of how to investigate crimes, which has been noted in previous research as a reason for the concerns and misconceptions about IGG. Participants agreed that educating all stakeholders and enacting appropriate policies and legislation to mitigate past

mistakes and concerns with misuse, misidentification, consent, privacy, and confidentiality would aid in keeping IGG as an investigative tool in law enforcement's toolbox.

As one of a few studies to directly ask a subset of the public for their perspectives and opinions on the use of IGG, concerns that arise in its use, and how and what to message to the public about the use of IGG, the present study adds to previous literature by directly identifying the beliefs and opinions of individuals, and in this study, of genealogists with experience in both traditional and genetic genealogy research. As noted in the literature review section, three other studies have directly surveyed or interviewed the public about IGG. First, Guerrini et al. (2018) surveyed 1,587 individuals in the United States to assess the public's opinion on law enforcement's access to genetic genealogy databases and customers' information. Second, Samuel and Kennett (2020) interviewed 45 members of the public and stakeholders in the United Kingdom to explore their views on IGG use. Finally, Perrin (2020) and Auxier et al. (2019) reported the survey results from 4,272 respondents in the United States regarding Americans' privacy beliefs and concerns, with Perrin (2020) specifically focusing on two questions about IGG. The present study interviewed eight genealogists in the United States, all having experience in genetic genealogy and two having used IGG.

As with previous interview and survey studies, most of the present study's participants were female and non-Hispanic White, and all were older. Similarly, all respondents in the present study indicated support for the use of IGG in specific investigations, such as those involving violent crimes and unidentified human remains. Similar to prior studies, the respondents in the present study supported law enforcement having access to genetic genealogy websites to obtain a list of genetic relatives and associated customer information. However, the data must be adequately accessed, meaning that the customers of those genetic databases provided informed consent and law enforcement followed all relevant policies. Unlike Guerrini

et al. (2018), the present study's participants did not support law enforcement bypassing guidelines and policies, such as creating fake profiles on genetic genealogy websites to enable them to search for genetic relatives, as had been done at the beginning of IGG's use.

Like the present study, Samuel and Kennett's (2020) study interviewed individuals, including five professional or self-reported experienced genealogists; however, their study focused on participants in the United Kingdom. Nevertheless, there were many similar responses between participants in the present study and Samuel and Kennett's study. Participants in both studies qualified their support by identifying concerns surrounding potential implications and ramifications on family members, consent, privacy, and misuse.

Like Samuel and Kennett (2020), the present study had participants who differed in their views of which was most personal or private: DNA or other publicly available information and records that detail individuals' day-to-day lives. In both studies, participants noted that DNA is one part of the investigation and not the only evidence used to arrest and convict individuals in IGG cases. Some participants in both studies valued the benefits of IGG in identifying perpetrators and the reliability of DNA as a unique identifier. In contrast, other participants did not believe DNA was utterly foolproof. The present study discussed this as mitigating risks, such as misidentifications. In Samuel and Kennett's study, it was discussed in terms of the reliability of IGG.

As with participants in Samuel and Kennett's (2020) study, some participants in the present study voiced concerns about the use of IGG negatively impacting the genealogy community. Some participants in both studies noted that issues brought up in the use of IGG are problems found in genetic genealogy research and have nothing to do with law enforcement, such as uncovering family secrets and other ethical concerns. In contrast, other participants pointed to existing issues as a reason why it was problematic to now have law enforcement

involved.

Of interest, considering that Samuel and Kennett's (2020) study involved participants in the United Kingdom and the present study focused on participants in the United States, was the fear by some participants in both studies that law enforcement would misuse this new technique based on prior incidents where law enforcement has abused its power, such as in the treatment of individuals from specific communities, ethnicities, and racial backgrounds. Both studies included participants who identified that some concerns like the mass collection of DNA samples to eliminate or identify perpetrators are not specific to IGG but are routine investigative activities in traditional investigations of crimes in which IGG would be used.

Like Samuel and Kennett's (2020) study, participants in the present study supported standards, regulation, oversight, legislation, and/or policies at different IGG process levels to address the issues and concerns raised in its use. For example, guidance would include the crimes it should be used in, the presence of informed consent, and the ability for individuals to choose whether law enforcement has access to their genetic data and contact information in genetic genealogy databases. Both studies had participants who were sufficiently satisfied with current oversight and policies. In contrast, others remained skeptical, believing there could still be misuse and overreach by law enforcement and lax genetic genealogy database companies.

Although it is harder to compare the results in the present study to the results of the Pew Research Center report on the privacy beliefs of Americans, Perrin (2020) did find that most respondents believed it was acceptable for DTC genetic services to share customer's genetic data with law enforcement to help solve crimes. Most respondents who felt this way were White women over 50 years old. Of interest and different from the present study was that only 16% of respondents had used a DTC genetic testing service in Perrin (2020). Also of interest, Auxier and colleagues (2019) reported that, in general, most Americans were more concerned about privacy

issues and control of data with companies than with the government.

Similar results were identified in the present study regarding prior research that did not involve a survey or interview research design. Multiple participants in the present study noted that the sensitivity of the information found in DNA and the level of control individuals have over their DNA data underscores risks and concerns regarding misuse, consent, privacy, and confidentiality. Some participants noted similar worries that family members who had not committed a crime or taken a DNA test would become part of a criminal investigation because a relative had taken a DNA test and opted into law enforcement matching in genetic genealogy databases. Now, these family members could be identified as genetic relatives and on the same family tree as the suspect of a crime whose crime scene DNA profile was uploaded into the same genetic genealogy database.

As with prior research, multiple participants differentiated between how IGG was first used and how it is used now, pointing out changes made by all the major private DTC genetic testing companies regarding their databases and the public genetic genealogy database GEDmatch. These changes addressed the consent, privacy, and confidentiality concerns identified in prior research. Many of the participants acknowledged it would become an issue if companies reverted to the early days or changed their policies, user agreements, and terms of service without advising the users of their services. Participants noted other significant changes in policy implementation, such as the DOJ interim policy in 2019 and the implementation of legislation at the state level in Maryland and Montana. Those participants in the present study who were more familiar with the policies and the use of IGG were aware that bookending CODIS searches are mandated to match the crime scene DNA profile already in CODIS to the suspect's DNA profile identified through IGG. Some participants knew of current restrictions in access to genetic genealogy databases, the types of crimes in which IGG can be used, and the

mandate directing law enforcement agencies to fully disclose their role as law enforcement when communicating with DTC genetic genealogy services. Some participants knew that law enforcement is forbidden access to individuals' raw genetic data.

Participants noted various benefits of using IGG and agreed with prior research to limit its use to the most serious offenses. Overall, the participants' answers supported observations made previously about finding a balance between everyone's privacy rights, the public's safety, and the right to justice for victims and survivors, with many participants citing justice, closure, and resolution as three of the most significant benefits of using IGG. However, it is hard to fully understand the power of justice, closure, and resolution unless one is a survivor of a violent crime or has family who has been impacted by a violent crime.

The present study's purpose was achieved because it identified the various perceptions, knowledge, and support for IGG held by study participants who may or may not have direct experience with IGG use at the time of the interviews. The ability to achieve this was increased because the study focused on targeting a profession with more knowledge than the public about concepts inherent in what IGG is and how it is used. In doing so, this study identified concerns and misconceptions regarding the use of IGG that could also be held by the public, impeding broader support for its use. Recognizing these concerns and misconceptions could lead to informed policymaking and campaigns to educate the public so that IGG continues to be used to solve violent crimes and identify human remains.

Although the study's purpose of interviewing genealogists was achieved, one of its limitations was its sample composition because the researcher was unable to identify and interview every genealogist that makes up the entire population of genealogists. Similarly, considering issues identified in the present study regarding the under-representation of certain races and ethnicities, the sample of genealogists was limited in its racial and ethnic diversity.

Issues of appropriate sample size raised another potential limitation, as was the primary focus on Texas-based genealogists. Only one participant did not reside in Texas but was a member of a Texas-based genealogical society. Finally, because of the infancy and nature of IGG, few participants who have used IGG were interviewed, which limits data collection that is not speculative about the use of IGG.

The researcher believes the qualitative data obtained from the interviews was robust. The study participants seemed at ease, took the appropriate time to answer questions, and articulated well, thought-out, comprehensive answers during the interviews. Although most participants were Texas-based genealogists, and this was identified as a potential limitation, states will enact their own policies or legislations; therefore, since this study also seeks to identify concerns and misconceptions to guide informed policymaking and educational campaigns, a strength of the study was its focus on identifying and mainly interviewing Texas-based study participants. Another strength of the present study was that although all participants were genealogists with experience using genetic genealogy, similar concerns and misconceptions identified in prior research still arose. Some of which have been mitigated to some degree by changes in or enactment of policies by public and private genetic genealogy databases, at the state level through legislation, by law enforcement agencies (e.g., Sacramento County District Attorney's Office), and at the federal level by DOJ. The fact that particular concerns and misconceptions still arise underscores the need for further education and awareness campaigns if IGG is to remain a tool in law enforcement's investigative toolbox.

The present study expanded research into the use of IGG and perceptions held regarding its use by interviewing genealogists, who make up part of the team in the IGG process. Although only two participants had used IGG, all participants were knowledgeable and experienced in genetic and traditional genealogy research with varied levels of expertise in both and were able

to provide thoughtful answers to the interview questions. Future research involving genealogists should seek to include a racially and ethnically diverse sample. Future research should also consider the perspective of criminal justice system members, survivors, and family members of victims whose cases have been solved using IGG. Additionally, future research should explore more deeply the concerns and misconceptions held by participants, including informing participants of existing policies and legislation, which this study could have done better. For example, when participants indicated concerns that law enforcement would start using IGG for all crimes, bypass using CODIS and go straight to IGG, and have access to raw DNA data, the researcher could have discussed the broad application of DOJ's interim policy beyond DOJ investigative agencies and the sections of DOJ's interim policy that address such concerns and asked whether their concerns were alleviated. Similarly, regarding concerns about sample and data control and disposition, the researcher could have discussed the section of DOJ's interim policy that directs this information to be treated as confidential government information guided by established laws, regulations, policies, and procedures.

Conclusion

IGG has been described as a game changer in the pursuit of justice and closure for the victims and the family members of victims of violent crimes and in providing answers to family members of missing persons. Since August 2020, several news stories in the Dallas-Fort Worth metroplex have been published regarding the use of IGG. However, the only case that has gone to trial in North Texas has been the case against 77-year-old Glen McCurley for the murder of 17-year-old Carla Walker in 1974. In August 2021, McCurley, who was arrested in September 2020, entered a guilty plea, days into his trial (Allen, 2021; Lucia, 2020). Detective Jay Bennett noted, "The satisfaction of being able to give the Walkers the answers they've been looking for, for almost 47 years is almost un-describable" (Lucia, 2020). Upon his guilty plea, Carla's brother

stated:

There were really dark times watching the pain my mom went through. ...The word that came across my brain was finally, finally. This is a resolution that's been prayed for.

...We have a name and face, and we're moving forward. Complete resolution. (Lucia, 2020)

In November 2021, Ray Anthony Chapa was identified as the rapist and killer of 32-year-old Janet Love in 1986 (Vandergriff, 2021). Chapa died in early 2021 before he could be arrested but has been linked to other sexual assaults in North Texas, and investigators are looking for potential victims in different locations he lived in (Vandergriff, 2021). Love's sister commented:

I'm very thankful that she wasn't forgotten. ...We all had to find a way to sort of resolve ourselves to the reality that we may never have any answers, that we may never know what happened. ...They [other victims] all deserve to feel some closure and some sense of justice in this, and I hope they get that. (Vandergriff, 2021)

For law enforcement agencies to continue to use IGG, the public must be educated on what it is and what it is not. This qualitative research study sought to identify the perspective of genealogists on the use of IGG. Through interviews of its participants, the study examined genealogists' perceptions and knowledge of IGG, their opinions regarding areas of concern that have been raised, and whether they support its use to solve crimes and identify human remains. All participants were able to discuss the benefits, potential risks, and in which kinds of crimes IGG should be used. In addition, they provided varied perspectives and personal experiences in discussing areas of concern that have been raised, such as misuse, misidentification, consent, privacy, and confidentiality.

All study participants were in favor of its use to solve violent crimes and identify human remains as long as policy and guidelines were followed, law enforcement accessed the

information in genetic genealogy databases of participants who had provided informed consent for that kind of access, or obtained legal process for DTC genetic genealogy companies requiring legal process. Nevertheless, it was evident that some participants were more knowledgeable of current policies and legislation and the limits, regulations, and oversight imposed on law enforcement in the use of IGG.

Because of the infancy of IGG and the significant issues and concerns that have emerged, it is crucial to set and follow policies, such as requiring a court-issued request or order be served to obtain cooperation from DTC genetic testing companies to search their databases or restricting the use of IGG to specific types of crimes to avoid losing the use of this technique. Likewise, legislation should be welcomed that does not severely inhibit law enforcement's use of IGG. For example, Bieber et al. (2006) noted that restricting the use of genetic genealogy by law enforcement to the most serious offenses could limit the opposition to its use. Still, they found that further evaluation of legal, ethical, and policy implications should be done in conjunction with assessing the potential value added to investigations. Kennett (2019) noted that the public's safety and a victim's right to justice must be balanced with everyone's privacy rights regardless of who has or has not taken a DNA test because one's DNA will always link one to others. Often, this balance results from legislation and challenges in court. As noted, the Supreme Court's decision in *Carpenter v. United States* (2018) has been cited in discussions of how the Fourth Amendment could apply to the use of IGG.

According to Katsanis (2020), "underregulated use of IGG" will threaten the "balance [of] public safety with the ideals of personal autonomy and anonymity," and it will take the public, the research community, and policymakers and scientists to help maintain that balance (p. 558). The researcher believes it is also the responsibility of those in the criminal justice system to help keep that balance. As the evolution of investigative techniques has shown us, there will

always be challenges to balancing privacy rights and protections with emerging investigative tools and techniques. Due mainly to the infancy of IGG's use by law enforcement, future research designed to identify misconceptions held not just by the public but also by genealogists and law enforcement officers who have not used IGG may drive future policies and legislation. Currently, there is no federal legislation regarding the use of IGG by law enforcement, and only two states have enacted legislation specific to IGG at the state level. This study could be replicated in various jurisdictions interested in gaining support for the use of IGG through policymaking and educational campaigns.

References

- Allen, J. (2021, August 24). *Forensic genealogy used in Glen McCurley case could help close thousands of unsolved murders*. CBS Dallas / Fort Worth.
<https://dfw.cbslocal.com/2021/08/24/forensic-genealogy-glen-mccurley-case-thousands-unsolved-murders/>
- Anderson, C. (2010). Presenting and evaluating qualitative research. *American Journal of Pharmaceutical Education*, 74(8), 1-7. <https://doi.org/10.5688/aj7408141>
- Arnaud, C. H. (2017, September 18). Thirty years of DNA forensics: How DNA has revolutionized criminal investigations. *C&EN*, 95(37), 16-20.
<https://cen.acs.org/analytical-chemistry/Thirty-years-DNA-forensics-DNA/95/i37>
- Auxier, B., Rainie, L., Anderson, M., Perrin, A., Kumar, M., & Turner, E. (2019, November 15). *Americans and privacy: Concerned, confused and feeling lack of control over their personal information*. Pew Research Center: Internet, Science & Tech.
<https://www.pewresearch.org/internet/2019/11/15/americans-and-privacy-concerned-confused-and-feeling-lack-of-control-over-their-personal-information/>
- Bieber, Frederick R., Brenner, Charles H., & Lazer, David. (2006, June 2). Finding criminals through DNA of their relatives. *Science*, 312(5778), 1315-1316.
<https://doi.org/10.1126/science.1122655>
- Bolnick, D. A., Fullwiley, D., Duster, T., Cooper, R. S., Fujimura, J. H., Kahn, J., Kaufman, J. S., Marks, J., Morning, A., Nelson, A., Ossorio, P., Reardon, J., Reverby, S. M., & TallBear, K. (2007, October 19). The science and business of genetic ancestry testing. *Science*, 318(5849), 399-400. <https://doi.org/10.1126/science.1150098>
- Brettell, T. A., Butler, J. M., & Saferstein, R. (2005, June 15). Forensic science. *Analytical Chemistry*, 77(12), 3839-3860. <https://doi.org/10.1021/ac050682e>

- Brown, K. (2002, March 1). Tangled roots? Genetics meets genealogy. *Science*, 295(5560), 1634-1635. <https://doi.org/10.1126/science.295.5560.1634>
- Callaghan, T. F. (2019, October 11). Responsible genetic genealogy. *Science*.
<https://science.sciencemag.org/content/366/6462/155>
- Carpenter v. United States, 585 U.S. _ (2018). <https://www.oyez.org/cases/2017/16-402>
- Diskin, M. (2020, August 18). *Survivors of the Golden State Killer face their tormentor, tell him to 'rot in hell.'* Ventura County Star.
<https://www.vcstar.com/story/news/local/2020/08/18/survivors-face-the-golden-state-killer-sentencing-hearing-joseph-deangelo/5587950002/>
- Etikan, I., Musa, S. A., & Alkassim, R. S. (2016). Comparison of convenience sampling and purposive sampling. *American Journal of Theoretical and Applied Statistics*, 5(1), 1-4.
<https://doi.org/10.11648/j.ajtas.20160501.11>
- FBI. (n.d.-a). *CODIS - NDIS statistics*. FBI. <https://www.fbi.gov/services/laboratory/biometric-analysis/codis/ndis-statistics>
- FBI. (n.d.-b). *CODIS and NDIS fact sheet*. FBI.
<https://www.fbi.gov/services/laboratory/biometric-analysis/codis/codis-and-ndis-fact-sheet#>
- FBI. (n.d.-c). *Combined DNA Index System (CODIS)*. FBI.
<https://www.fbi.gov/services/laboratory/biometric-analysis/codis>
- Gordon, S. (2019, December 13). *DNA used to solve decades-old cold case murder of 11-year-old Julie Fuller*. NBC 5 Dallas-Fort Worth. <https://www.nbcdfw.com/news/local/dna-used-to-solve-decades-old-cold-case-murder-of-11-year-old-julie-fuller/2273172/>
- Greytak, E. M., Kaye, D. H., Budowle, B., Moore, C., & Armentrout, S. L. (2018, August 31). Privacy and genetic genealogy data. *Science*, 361(6405), 857.

<https://doi.org/10.1126/science.aav0330>

Greytak, E. M., Moore, C., & Armentrout, S. L. (2019). Genetic genealogy for cold case and active investigations. *Forensic Science International*, 299, 103–113.

<https://doi.org/10.1016/j.forsciint.2019.03.039>

Guerrini, C. J., Robinson, J. O., Petersen, D., McGuire, A. L. (2018). Should police have access to genetic genealogy databases? Capturing the Golden State Killer and other criminals using a controversial new forensic technique. *PLoS Biology*, 16(10), 1-9.

<https://doi.org/10.1371/journal.pbio.2006906>

Guerrini, C. J., Wickenheiser, R. A., Bettinger, B. T., McGuire, A. L., & Fullerton, S. (2021). Four misconceptions about investigative genetic genealogy. *Journal of Law and the Biosciences*, 8(1), 1-18. <https://doi.org/10.1093/jlb/lsab001>

Hazel, J. W., Clayton, E. W., Malin, B. A., & Slobogin, C. (2018, November 23). Is it time for a universal genetic forensic database? *Science*, 362(6417), 898-900.

<https://doi.org/10.1126/science.aav5475>

International Society of Genetic Genealogy. (n.d.-a). Genetics glossary. In *Genetics Glossary – ISOGG Wiki*. Retrieved July 4, 2021, from https://isogg.org/wiki/Genetics_Glossary

International Society of Genetic Genealogy. (n.d.-b). History of genetic genealogy. In *Timeline: History of genetic genealogy*. Retrieved July 4, 2021, from

https://isogg.org/wiki/Timeline:History_of_genetic_genealogy

Janzen, T. (2022). *Autosomal DNA testing comparison chart*. ISOGG Wiki. Retrieved March 31, 2022, from https://isogg.org/wiki/Autosomal_DNA_testing_comparison_chart

Katsanis, S. H. (2020). Pedigrees and perpetrators: Uses of DNA and genealogy in forensic investigations. *Annual Review of Genomics and Human Genetics*, 21, 535–564.

<https://doi.org/10.1146/annurev-genom-111819-084213>

- Kennett, D. (2019). Using genetic genealogy databases in missing persons cases and to develop suspect leads in violent crimes. *Forensic Science International*, 301, 107–117.
<https://doi.org/10.1016/j.forsciint.2019.05.016>
- Kolenc, A. B. (2020, July 15). *A practitioner's guide to police use of genealogy sites and the Fourth Amendment*. American Bar Association.
https://www.americanbar.org/groups/criminal_justice/publications/criminal-justice-magazine/2020/summer/a-practitioners-guide-police-use-genealogy-sites-and-fourth-amendment/
- Lofland, J., Snow, D. A., Anderson, L., Lofland, L. H. (2006). *Analyzing social settings: A guide to qualitative observation and analysis*. Wadsworth.
- Lucia, A. (2020, September 22). “Finally, Finally:” Suspected killer of Fort Worth teen Carla Walker arrested for capital murder 46 years later. CBS Dallas / Fort Worth.
<https://dfw.cbslocal.com/2020/09/22/suspected-killer-fort-worth-teen-carla-walker-arrested-capital-murder/>
- Machado, H., & Silva, S. (2015). Public participation in genetic databases: Crossing the boundaries between biobanks and forensic DNA databases through the principle of solidarity. *Journal of Medical Ethics*, 41(10), 820-824.
<https://doi.org/10.1136/medethics-2014-102126>
- Maschke, K. J. (2008). Biobanks: DNA and research. In M. Crowley (Ed.), *From birth to death and bench to clinic: The Hastings Center bioethics briefing book for journalists, policymakers, and campaigns* (pp. 11–14). <https://www.thehastingscenter.org/wp-content/uploads/Biobanks-DNA-and-Research-BB3.pdf>
- Maxfield, M. G., & Babbie, E. R. (2016). *Basics of research methods for criminal justice & criminology* (4th ed.). Cengage Learning.

- Mittelman, D. (2021). Heating up cold cases: An interview with Bruce Budowle on human identification. *Forensic Genomics*, 1(1), 7-10.
<https://doi.org/10.1089/forensic.2020.29000.int>
- Mullin, E. (2021, October 21). *States are toughening up on genetic privacy*. Wired.
<https://www.wired.com/story/states-are-toughening-up-privacy-laws-for-at-home-dna-tests/>
- Murphy, E. (2009, November 2). Relative doubt: Familial searches of DNA databases. *Michigan Law Review*, 109, 291-348. <http://ssrn.com/abstract=1498807>
- National Geographic. (n.d.). *Genographic DNA ancestry discontinuation: About the project*. National Geographic Partners Support Center.
<https://help.nationalgeographic.com/s/article/Genographics-DNA-Ancestry>
- National Human Genome Research Institute. (n.d.-a). *DNA sequencing fact sheet*. Retrieved July 4, 2021, from <https://www.genome.gov/about-genomics/fact-sheets/DNA-Sequencing-Fact-Sheet>
- National Human Genome Research Institute. (n.d.-b). *A brief guide to genomics*. Retrieved July 4, 2021, from <https://www.genome.gov/about-genomics/fact-sheets/A-Brief-Guide-to-Genomics>
- Perrin, A. (2020, February 4). *About half of Americans are OK with DNA testing companies sharing user data with law enforcement*. <https://www.pewresearch.org/fact-tank/2020/02/04/about-half-of-americans-are-ok-with-dna-testing-companies-sharing-user-data-with-law-enforcement/>
- Plemel, E. (2019). Genetic genealogy and its use in criminal investigations: Are we heading towards a universal genetic database? *Dalhousie Journal of Interdisciplinary Management*, 15, 1-15. <https://doi.org/10.5931/DJIM.V15I0.8983>

- Prainsack, B., & Aronson, J. D. (2015). Forensic DNA databases: Ethical and social dimensions. In J. D. Wright (Ed.), *International encyclopedia of the social & behavioral sciences* (Second, Vol. 9, pp. 339-345). Elsevier. <http://dx.doi.org/10.1016/B978-0-08-097086-8.82062-0>
- Regalado, A. (2019, February 11). *More than 26 million people have taken an at-home ancestry test*. MIT Technology Review. <https://www.technologyreview.com/2019/02/11/103446/more-than-26-million-people-have-taken-an-at-home-ancestry-test/>
- Roth, A. (2020). Admissibility of DNA evidence in court. In H. Erlich, E. Stover, & T. J. White (Eds.), *Silent witness* (pp. 291-310). Oxford University Press.
- Royal, C. D., N., J., Fullerton, S. M., Goldstein, D. B., Long, J. C., Bamshad, M. J., & Clark, A. G. (2010, May 14). Inferring genetic ancestry: Opportunities, challenges, and implications. *The American Journal of Human Genetics*, 86(5), 661-673. <https://doi.org/10.1016/j.ajhg.2010.03.011>
- Sacramento County District Attorney's Office. (n.d.). *Memorandum of investigation: Investigative genetic genealogy searching*. Retrieved on June 23, 2021, from <https://chia187.wildapricot.org/resources/Documents/Sacramento%20County%20District%20Attorney%27s%20Office%20-%20IGG%20MOU%20Example.pdf>
- Samuel, G. & Kennett, D. (2020). The impact of investigative genetic genealogy: Perceptions of UK professional and public stakeholders. *Forensic Science International: Genetics*, 48, 1-9. <https://doi.org/10.1016/j.fsigen.2020.102366>
- Scientific Working Group DNA Analysis Methods (2020, February 18). *Overview of investigative genetic genealogy*. https://1ecb9588-ea6f-4feb-971a-73265dbf079c.filesusr.com/ugd/4344b0_6cc9e7c82ccc4fc0b5d10217af64e31b.pdf

- Sentendrey, D. (2019, December 12). *DNA helps solve Fort Worth 11-year old's murder nearly 40 years later*. FOX 4 News Dallas-Fort Worth. <https://www.fox4news.com/news/dna-helps-solve-fort-worth-11-year-olds-murder-nearly-40-years-later>
- Shapiro, E. D., & Reifler, S. (1996). Forensic DNA analysis and the United States government. *Medicine, Science and the Law*, 36(1), 43-51. <https://doi.org/10.1177/002580249603600109>
- Smith, M. (2022, January 23). *DNA fingerprinting: Purpose, procedure, and how it's used*. WebMD. <https://www.webmd.com/a-to-z-guides/dna-fingerprinting-overview>
- Stanton, S., Egel, B., & Lillis, R. (2018, April 25). *East Area Rapist suspect captured after DNA match, authorities say*. The Sacramento Bee. <https://www.sacbee.com/news/article209779364.html>
- Stanton, S. & Smith, D. (2020, August 21). *'DeAngelo says 'I'm truly sorry,' sentenced to life for Golden State Killer rape-murder spree*. The Sacramento Bee. <https://www.sacbee.com/news/article245135085.html>
- Stanton, S., Smith, D., Kasler, D. & Sullivan, M. (2020, June 29). *'Day of reckoning'—Joseph DeAngelo admits guilt in Golden State Killer murders, rapes*. The Sacramento Bee. <https://www.sacbee.com/news/article243868517.html>
- Taylor, M. (2021, June 30). Maryland, Montana become first states to restrict genetic genealogy searches. *Forensic*. <https://www.forensicmag.com/577298-Maryland-Montana-Become-First-States-to-Restrict-Genetic-Genealogy-Searches/>
- Thomas, W. F. (2021). The family perspective. *Forensic Genomics*, 1(1), 4-6. <https://doi.org/10.1089/forensic.2020.0002>
- Tibbetts, J. H. (2020, May). Is forensic science scientific? Crime lab errors and privacy issues raise concerns. *BioScience*, 70(5), 377-382. <https://doi.org/10.1093/biosci/biaa022>

- Tyack, J. & Cline, H. (2019, May 24). *Genetic testing and the Fourth Amendment*. Columbus Bar Association.
- https://www.cbalaw.org/CBA_PROD/Main/News_Items/Genetic_Testing_and_the_Fourth_Amendment.aspx
- U.S. Department of Justice. (2019, September 2). Interim policy on forensic genetic genealogical DNA analysis and searching. <https://www.justice.gov/olp/page/file/1204386/download>
- U.S. National Library of Medicine. (n.d.-a). *Cells and DNA*. MedlinePlus.
- <https://medlineplus.gov/genetics/understanding/basics/>
- U.S. National Library of Medicine. (n.d.-b). *What is genetic ancestry testing?* MedlinePlus.
- Retrieved June 23, 2021, from
- <https://medlineplus.gov/genetics/understanding/dtcgeneticstesting/ancestrytesting/>.
- Vandergriff, C. (2021, November 16). “*Thankful she wasn’t forgotten,*” family of murder victim Janet Love gets closure 35 years later. CBS Dallas / Fort Worth.
- <https://dfw.cbslocal.com/2021/11/16/janet-love-murder-case-closed/>
- Vogt, W. P. & Johnson, R. B. (2015). *The SAGE dictionary of statistics & methodology: A nontechnical guide for the social sciences* (5th ed.). SAGE.
- Willing, R. (2005, June 7). *Suspects get snared by a relative’s DNA*. USA Today.
- https://usatoday30.usatoday.com/news/nation/2005-06-07-dna-cover_x.htm
- Wolinsky, H. (2006, October 20). Genetic genealogy goes global. Although useful in investigating ancestry, the application of genetics to traditional genealogy could be abused. *EMBO reports*, 7(11), 1072–1074. <https://doi.org/10.1038/sj.embor.7400843>
- YourGenome. (2021, July 21). *What is a DNA fingerprint?*
- <https://www.yourgenome.org/facts/what-is-a-dna-fingerprint>

Appendix A

Semi-Structured Interview Schedule: Genealogists

Thank you for taking the time to answer a couple of questions and have a conversation with me about several topics related to the use of investigative genetic genealogy, such as genealogy in general, the kinds of crimes it has been used in and should be used in, and concerns with privacy, confidentiality, ethics, and collection of data. I hope to use this information to identify differences in the support for its use and ways in which to address concerns that have been raised about its use, whether they be addressed through policymaking or educational campaigns. The interview should take no longer than 45 minutes. During the interview, you may skip any question, omit specific answers, and withdraw from the interview at any time without any negative repercussions. After the interview, you may notify me if you want to withdraw specific answers or withdraw completely from participating in this study, which will result in the removal of your data, including the interview and any notes and/or the transcript associated with the interview.

We will begin with a couple of demographic questions before discussing your profession.

1. What is your age?
2. What is your gender?
3. What is your race/ethnicity?
4. What is your highest educational level?
5. What is your degree in?

I would also like to record our interview to assist in accurately capturing our interview and recalling its content later. Would you be willing to have the interview recorded?

6. Is genealogy your career?
7. How long have you been involved in genealogy?
8. What got you interested in genealogy?
9. Do you consider yourself a professional or amateur genealogist?
10. What kind of genealogical research do you conduct?
11. Do you know any law enforcement officers?

We will now discuss investigative genetic genealogy, in general, as well as your thoughts on some of the concerns that have been raised in its use.

12. How would you describe investigative genetic genealogy?
 - a. When did you first hear about IGG?
13. Do you support the use of IGG?
 - a. Why or why not?
14. What benefits or capabilities, if any, are there in using IGG?
15. Have you had an opportunity to use IGG?
16. Are there specific kinds of crimes or cases in which you think IGG should be applied?
17. What risks, if any, are there in using IGG?

Concerns raised in the use of IGG stem mostly from the fact that the DNA profiles being used to compare to the crime scene DNA profiles come from public or private genetic databases whose purpose has not been for law enforcement's access and use to solve crimes. Some of these areas of concern include privacy, confidentiality, consent and control regarding one's genetic data, and misuse and misidentification. These concerns extend to family members of individuals who have not provided their genetic data. The following questions pertain to IGG/law enforcement's use of it

18. What are your thoughts on whether the use of IGG infringes on the *privacy rights of individuals* who submit their DNA tests for purposes other than law enforcement's use of IGG?
 - a. *Of their family members?*
19. What are your thoughts regarding *confidentiality of individuals* in the use of IGG?
 - a. *Of their family members?*
20. What are your thoughts regarding *consent and control of an individual's genetic data* in the use of IGG?
21. What are your thoughts regarding *misuse and misidentification* in the use of IGG?
22. What would you like the public to know about the use of IGG from the perspective of your profession as a genealogist?
23. If you believe the use of IGG is a game changer in solving certain crimes, what could be done to gain support from the public for its use?
24. Is there anything you would like to add about IGG or a related topic that we have not discussed?
25. If I need to contact you for clarification purposes, how do you prefer to be contacted? Via email, phone call, or meet in person?

Thank you for taking the time to have a conversation with me about several topics related to the use of investigative genetic genealogy. As noted at the beginning, the goal of this study is to identify differences in the support for its use and ways in which to address concerns that have been raised about its use. Knowing the concerns and misconceptions that exist could lead to informed policymaking and campaigns to educate the public, so that IGG can continue to be used to solve cold cases and specific violent crime investigations and to identify unidentified human remains. We discussed some of those concerns as you answered questions about privacy, confidentiality, ethics, and collection of data.

26. Would you like to be informed of the results of the study?
27. Currently, do you have any questions regarding the study?

As noted in the consent form, for any questions regarding the study, you should contact:

Me, Laritza Diazgonsen, Graduate Student at TCU, l.diazgonsen20@tcu.edu, and (956) 497-9898; or

Dr. Kendra Bowen, Associate Professor of Criminal Justice at TCU, k.bowen@tcu.edu, and (817) 257-4971.

For any concerns regarding your rights as a study participant, you should contact:

*Dr. Dru Riddle, Chair, TCU Institutional Review Board, (817) 257-6811, d.riddle@tcu.edu;
or*

Dr. Floyd Wormley, Associate Provost of Research, research@tcu.edu

In closing, I want to remind you that if you want to withdraw specific answers or withdraw completely from participating in this study, which will result in the removal of your data, including the interview and any notes and/or the transcript associated with the interview, you may notify me directly. I ask that you do so as soon as you make that decision to ensure it is not too late and the study has been completed.

Appendix B

Table B1

Comparison of Five Major Genetic Genealogy Companies or Databases

Characteristic	23andMe	AncestryDNA	MyHeritage	FamilyTreeDNA	GEDmatch / GEDmatch Pro
Date founded	November 19, 2007	May 3, 2012 (in the U.S.)	November 7, 2016	February 16, 2010	2010 / December 2020
Private or public	Private	Private	Private	Private	Public
Number of people in the database (as of April 15, 2022)	12,200,000	21,000,000+	5,600,000	1,770,000	1,500,000
Source for number of people in the database	GlobeNewswire website	Impact report from Ancestry.com, March 23, 2022	MyHeritage presentation, November 7, 2021	Personal estimate by Tim Janzen	Verogen report, April 7, 2021
Provides opt-in or opt-out option for law enforcement access	No	No	No	Yes	Yes
Allows law enforcement to submit or upload SNP profiles	No	No	No	Yes, but restricted to the opt-in section of the database and with required documentation	Yes, but restricted and through its GEDmatch Pro portal
Requires a subpoena, search warrant, or valid court order	Yes, but will resist	Yes, but will resist	Yes, but will resist	No, but requires documentation requesting permission and case-related information	No, but law enforcement uses the GEDmatch Pro portal
Provides a guide for law enforcement	Yes	Yes	No, but its Terms and Conditions and Privacy Policy address law enforcement attempts to access the database	Yes	Yes, through its GEDmatch Pro portal
Specifies kinds of investigations	N/A	N/A	N/A	Yes, remains of deceased individuals and perpetrators of homicide, sexual assault, or abduction	Yes, violent crimes (murder, non-negligent manslaughter, aggravated rape, aggravated assault, robbery) and identifying human remains

Note. Adapted from Guerrini et al. (2021) and *Autosomal DNA Testing Comparison Chart*, by T. Janzen, 2022 (https://isogg.org/wiki/Autosomal_DNA_testing_comparison_chart). CC BY-NC-SA 3.0.